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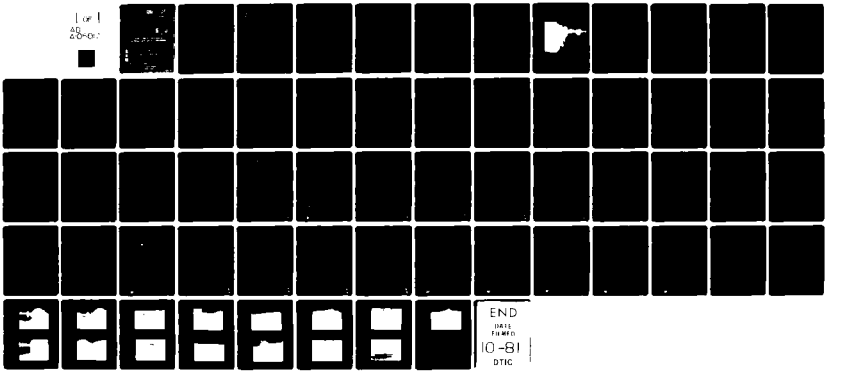

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MISSISSIPPI-ST. FRANCIS RIVER BASIN

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BARTLETT'S FISHING LAKE DAM
STODDARD COUNTY, MISSOURI
MO 40046

(15) DACW43-81-C-0010

(9) Final rept. (11) Apr 81

(10) Nathan/Wilcoxon Guy/Freese
Timothy P. /Tappendorf

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PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

(6) Bartlett's Fishing Lake Dam (MO 40046).
Mississippi - St. Francis River Basin.
Stoddard County, Missouri. Phase I
Inspection Report.

United States Army
Corps of Engineers
St. Louis District

PREPARED BY U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
FOR STATE OF MISSOURI

APRIL 1981

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REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A105017	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Bartlett's Fishing Lake Dam (MO 40046) Stoddard County, Missouri	5. TYPE OF REPORT & PERIOD COVERED Final Report 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Crawford, Murphy & Tilly, Inc.	8. CONTRACT OR GRANT NUMBER(s) DACW43-81-C-0010
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	12. REPORT DATE April 1981 13. NUMBER OF PAGES Approximately 50
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Bartlett's Fishing Lake Dam

Stoddard County, Missouri
Missouri Inventory No. 40046

This report presents the results of field inspection and evaluation of the Bartlett's Fishing Lake Dam (MO 40046). It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY: SIGNED
Chief, Engineering Division

23 JUN 1981
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

23 JUN 1981
Date

MISSISSIPPI - ST. FRANCIS RIVER BASIN

BARTLETT'S FISHING LAKE DAM
STODDARD COUNTY, MISSOURI
MISSOURI INVENTORY NO. 40046

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared By

Crawford, Murphy & Tilly, Inc., Springfield, Illinois
A & H Engineering Corporation, Carbondale, Illinois

Under Direction Of

St. Louis District, Corps of Engineers

For

Governor of Missouri

APRIL, 1981

PREFACE

This report is prepared under guidance contained in Department of the Army, Office of the Chief of Engineers, Recommended Guidelines For Safety Inspection Of Dams, for a Phase I investigation. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigation, testing and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. Additional data or data furnished containing incorrect information could alter the findings of this report.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
SUMMARY

Name of Dam: Bartlett's Fishing Lake Dam
State Located: Missouri
County Located: Stoddard
Stream: Tributary of Dudley Main Ditch
Date of Inspection: 5 December 1980

BRIEF ASSESSMENT

Bartlett's Fishing Lake Dam was inspected by an interdisciplinary team of engineers from Crawford, Murphy & Tilly, Inc. of Springfield, Illinois and A & H Engineering Corp. of Carbondale, Illinois. The purpose of this inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and they have been developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, the St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur if the dam fails. The estimated damage zone extends approximately one mile downstream of the dam. Located within this zone are numerous dwellings, commercial establishments, U. S. Highway 60 and outbuildings.

The dam is in the small size classification, since it is 20 feet high and the maximum storage capacity is greater than 50 acre-feet but less than 1,000 acre-feet.

Our inspection and evaluation indicates that the spillway does meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillway will pass approximately 85 percent of the Probable Maximum Flood without overtopping. The Probable Maximum Flood is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The guidelines require that a dam of small size with a high downstream hazard potential pass 50 to 100 percent of the PMF. The dam has a relatively small height of 20 feet, a small maximum storage capacity of 76 acre-feet, and a small drainage area of 44.5 acres. The floodplain is nearly flat for almost 1000 feet on each side of the downstream channel. Therefore any flood or dam breach discharges could be expected to spread out and obtain maximum depths of only several feet on the floodplain and the chance for loss of life is considered small. Considering this, 50 percent of the PMF has been determined to be the appropriate spillway design flood. The 100-year flood (1 percent probability flood) will not overtop the dam. The 1 percent probability flood is one that has a 1 percent chance of being equalled or exceeded in any given year.

The dam and spillway appear to be in poor condition. Deficiencies visually observed by the inspection team were: (1) moderate to considerable erosion of embankment slopes, (2) growth of trees, brush and weeds on the embankment, (3) minor sloughing on the embankment, (4) sparse vegetal cover over much of the embankment, (5) a flow restriction (wire fences) across the spillway channel, and (6) an earth channel spillway which has a potential for considerable erosion during overflow events. Another deficiency was the lack of seepage and stability analysis records.

It is recommended that the owners take the necessary action in the near future to correct the deficiencies reported herein. The embankment slopes are steep and subject to erosion and prompt attention is recommended for this deficiency. A detailed discussion of these deficiencies is included in the following report.

Nathan Wilcoxon, P.E.
Crawford, Murphy & Tilly, Inc.

Guy Freese, P.E.
A & H Engineering Corporation

Timothy P. Tappendorf, E.I.T.
Crawford, Murphy & Tilly, Inc.

PHOTOGRAPH 1. OVERVIEW OF BARTLETT'S FISHING LAKE DAM

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
BARTLETT'S FISHING LAKE DAM
MISSOURI INVENTORY NO. 40046

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APPENDICES

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL:

A. Authority:

The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection be made of Bartlett's Fishing Lake Dam in Stoddard County, Missouri.

B. Purpose of Inspection:

The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and a visual inspection, in order to determine if the dam poses hazards to human life or property.

C. Evaluation Criteria:

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, Recommended Guidelines for Safety Inspection of Dams. These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT:

A. Description of Dam and Appurtenances:

Bartlett's Fishing Lake Dam is an earth fill structure approximately 20 ft. high and 1,090 ft. long at the crest. The appurtenant works consist of an earth channel spillway cut into the original earth at the right abutment.

In this report right and left orientation are based on looking in the downstream direction.

A plan and typical cross-sections of the dam are shown on Plates 4, 5, and 6 of Appendix A.

B. Location:

The dam is located in the south central part of Stoddard County, Missouri on a tributary of the Dudley Main Ditch. The dam and lake are within the Dexter, Missouri 7.5 minute quadrangle map, Section 16 of Township 29 North, Range 13 East of the 5th Principal Meridian (latitude 36°48.6', longitude 89°59.1'). Included in Appendix A are a location map for the dam on Plate 1 and a vicinity map on Plate 2.

C. Size Classification:

With an embankment height of 20 ft. and a maximum storage capacity of approximately 76 acre-feet, the dam is in the small size category. A small size dam has a height greater than 25 feet but less than 40 feet and/or a maximum storage capacity greater than 50 acre-feet but less than 1,000 acre-feet.

D. Hazard Classification:

This dam is classified as a potential high hazard dam by the St. Louis District, Corps of Engineers. The estimated damage zone extends approximately one mile downstream of the dam. Within this zone are numerous dwellings, commercial establishments, outbuildings, and U.S. Highway 60. The affected items within the damage zone were verified by the inspection team.

E. Ownership:

The dam was constructed by Howard Bartlett and sold to the present owner who is Joe Vinson, R. R. #2, Crestview Drive, Dexter, Missouri 63841; telephone (314) 624-3276.

F. Purpose of Dam:

The dam was originally constructed to serve as a fishing lake. The lake is now used primarily as a refuge for waterfowl.

G. Design and Construction History:

Mr. Howard Bartlett, the original owner of the dam, was interviewed by telephone prior to the inspection. He indicated that he constructed the dam the way he wanted it in 1969 to form a fishing lake. Mr. Bartlett indicated that no design computations, plans, or investigations were done and that there had not been any inspections of the dam when he sold it. The lake and dam were sold to Mr. Joe Vinson in 1977 or 1978. The dam was modified in 1979 by the present owner who reported that a section of the embankment had sloughed off. Additional fill was added along the entire crest of the dam raising it approximately two feet. The surface of the crest was covered with gravel to allow vehicular access.

H. Normal Operating Procedures:

Control of the lake is by flow through an uncontrolled earth channel spillway. The owner related that the maximum stage in the reservoir was at an elevation three feet below the crest of the dam. The dam and spillway are maintained on an "as needed" basis by the owner.

1.3 PERTINENT DATA:

A. Drainage Area (Acres):	44.5
B. Discharge at Damsite (CFS):	
Maximum known flood at damsite	Reported to be 3 feet below crest (approx. elevation 410)

Drawdown facility capacity at maximum pool (85% PMF)	Not applicable
Principal spillway capacity at maximum pool	464
Emergency spillway capacity at maximum pool	Not applicable
Total spillway capacity at maximum pool	464
C. Elevation (Ft. Above MSL):	
Top of dam (Minimum Crest Elevation)	412.4
Streambed at downstream toe of dam	392.4
Normal pool	Fluctuates below elevation 409.6
Spillway crest	409.9
Pool elevation during inspection 5 Dec. 1980	407.9
Apparent high water mark	410
Maximum tailwater	Unknown
D. Reservoir Lengths (Feet):	
At top of dam	810
At spillway crest	790
At emergency spillway crest	Not applicable
E. Storage Capacities (Acre-Feet):	
At top of dam	76
At spillway crest	46.5
At emergency spillway crest	Not applicable
At pool level during inspection 5 Dec. 1980	28
At elevation of apparent high water mark	47
F. Reservoir Surface Areas (Acres):	
At top of dam	11.8
At spillway crest	10.7

At emergency spillway crest	Not applicable
At pool level during inspection 5 Dec. 1980	8.4
At elevation of apparent high	10.8
G. Dam:	
Type	Earthfill embankment
Length of crest (feet)	1090
Height (feet)	20
Top width (feet)	8
Side slopes (Horizontal:Vertical)	
Upstream	Varies from 1.6:1 to 2:1
Downstream (See cross section of dam on Plates 5 and 6, Appendix A)	Varies from 1.7:1 to 2:1
Zoning	Unknown
Impervious Core	Unknown
Cutoff	Unknown
Grout curtain	Unknown
H. Diversion and Regulating Tunnel:	None
I. Spillway:	
I.1 Principal Spillway:	
Location	Immediately right of the right abutment
Type	Excavated trapezoidal grass lined earth channel
Crest elevation (feet above MSL)	409.9
Effective length of weir (feet)	15
Channel U/S of control section	Approx. 24' long;-3.5% slope
Control section (See Exhibit 5 of App. B)	Approx. 20' long; variable slopes

Channel D/S of control section	Approx. 39' long; 3.1% slope for the first 13'; 0.9% slope for additional 26'
Side slopes	Variable (See cross sections on Exhibit 4 of Appendix B)
I.2 Emergency Spillway:	None
J. Regulating Outlets:	None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

There are no engineering data for Bartlett's Fishing Lake Dam.

A. Surveys:

No detailed surveys of the lake and dam have been made to our knowledge.

B. Foundation and Embankment Design:

No foundation investigations or design computations were made for the dam.

C. Hydrology and Hydraulics:

No hydrologic or hydraulic computations were made for the dam.

D. Structures:

There are no structures other than the embankment.

2.2 CONSTRUCTION:

The construction of the dam was reported to have been completed in 1969. No construction data were available. Mr. Howard Bartlett (original owner) was responsible for the construction of the dam.

2.3 OPERATION:

There are no operating facilities at the dam. When the pool level reaches the spillway crest elevation, flows are discharged through the earth channel spillway.

2.4 EVALUATION:

A. Availability:

No engineering data, seepage or stability analyses, hydrologic or hydraulic analyses or construction inspection data were available.

B. Adequacy:

Due to the lack of engineering and construction data, a detailed assessment of the design, construction and operation of this structure could not be made. The fact that no seepage and stability analyses comparable to the requirements of the Recommended Guidelines for Safety Inspection of Dams were available is a deficiency which should be corrected. The seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

C. Validity:

No conclusions can be drawn concerning the validity of the original design and construction of the dam due to unavailability of such data.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

A. General:

The field inspection was made on 5 December, 1980. The inspection team consisted of personnel from Crawford, Murphy & Tilly, Inc. of Springfield, Illinois, and A & H Engineering Corporation of Carbondale, Illinois. The team members were:

Nathan Wilcoxon, P.E., CM&T, Inc.
Timothy Tappendorf, E.I.T., CM&T, Inc.
Guy Freese, P.E., A & H Engineering Corp.

The field inspection included the determination of dimensions and elevations of the dam and appurtenances necessary to establish a plan view, a dam profile, a spillway profile and section, and cross sections of the dam. For this inspection all elevations were obtained by using an elevation shown on the U.S.G.S. 7.5 minute topographical map. This elevation (373' MSL) is located at a "T" road intersection at the center of the south line of Section 16 approximately 0.6 miles to the southeast of the dam site.

A visual inspection of the dam, spillway, drainage area and downstream channel was performed and photographs were taken of each of them. Photographs are presented in Appendix C.

Maps and general drawings of the dam and appurtenances are presented on Plates 1 through 6 of Appendix A and a hydrologic and hydraulic analysis is presented in Appendix B.

Prior to the inspection the owner of the dam was interviewed by the inspection team at his place of business. The owner did not accompany the inspection team during the inspection.

B. Regional and Project Geology:

The general southeastern Missouri area is underlain wholly or partially by Coastal Plain sediments. The Ozark Escarpment, which is the northwestern boundary, divides the lowland area from the Ozark Province. This is an irregular boundary which trends northeast by southwest from the southern sections of Cape Girardeau County through Bollinger County, Wayne County, Butler County and into Arkansas. All of Stoddard County (of the Mississippi embayment) is underlain by sediments of the Ozark Escarpment.

The Mississippi embayment is a broad arm of the Gulf Coastal Plain which extends up the Mississippi River Valley from the Gulf of Mexico. The embayment is structurally a downwarped, spoon-shaped trough developed on the Paleozoic rocks. Unconsolidated to poorly consolidated sediments of Mesozoic and Cenozoic ages have been deposited in this trough which is roughly marked by the course of the Mississippi River.

One of the most prominent topographic features of the embayment is Crowley's Ridge of central Stoddard County and northern Dunklin County. The dam site lies on the edge of the central portion of Crowley's Ridge.

Throughout Stoddard County, tertiary deposits overlie Cretaceous bedrock, which is usually found at the northern base of Crowley's Ridge. The tertiary deposits (Midway, Wilcox and Lafayette groups) comprise the subsurface geology of Crowley's Ridge in Stoddard County. The area of the dam site, which is located on the edge of the central section of Crowley's Ridge, is dominated by all three groups in the Tertiary System and is located northwest of the probable fault zone which parallels Crowley's Ridge.

Surface soils, consisting of a yellow-brown modified leoss (CL) cover the dam site area and are approximately 5 to 15 feet thick. These soils are exposed in the immediate project area. The tertiary deposits underlie the loess soils. The Lafayette formation, consisting of gravel and interbedded sand and clay, was observed below the dam along the deeper stream beds. The Ackerman and Holly Springs formations consist of approximately 75 feet of sand with several well developed clay zones. A thick basal sand exists in the lower sections. These deposits are underlain by the Midway group, consisting of the Clayton and Porters Creek formations. The Porters Creek formation consists of approximately 135 feet of blue-gray clay with siderite and silt in the upper sections and glauconitic, calcareous clay in the lower sections. The Clayton formation consists of approximately 15 feet of glauconitic limestone and calcareous clay. Bedrock does not appear to affect this dam.

The dam site is located in Seismic Zone 3 as shown on the Seismic Zone Map on Plate 3 of Appendix A. The site is located west of the New Madrid area which is seismically active at the present time.

A shallow soil sample was obtained from the embankment near the center of the crest. The sample was classified as a brown silty clay with some sand and gravel (CL). The potential for erosion is moderate for this soil type.

C. Dam:

Bartlett's Fishing Lake Dam is an earthfill dam with a height of approximately 20 feet and a length at the crest of approximately 1090 feet. There is a trapezoidal channel cut into natural ground just right of the right abutment which serves as the spillway. There is no emergency spillway or drawdown facility at the dam.

The embankment appears to be in poor condition. Both the horizontal and vertical alignment of the crest of the dam are non-uniform. The embankment bends at each abutment form a "U" shape (see Plate 4 of Appendix A). The non-uniformity of the horizontal alignment is due to the fact that these bends are not smooth curves. The non-uniform alignment appeared to be the result of the original construction. The vertical alignment varies from an elevation of approximately 412.4 feet at the right abutment to 415.8 feet approximately 50 feet away from the lowest point (see Exhibit 3 of Appendix B). The variation in the elevation of the top of the dam appeared to be the result of original construction or the additional fill added in 1979.

The upstream and downstream slopes of the embankment vary from approximately 1.6 horizontal to 1 vertical to 2 horizontal to 1 vertical, the steepest part being near the top of the upstream face. Cross sections of the embankment are shown on Plates 5 and 6 of Appendix A. Perhaps some of the steeper slopes may be attributable to the additional fill (reported to be approximately 2 feet deep) placed on the crest. Minor sloughing has occurred at scattered locations on both the upstream and downstream slopes of the embankment. The sloughing consisted of localized surface sliding with depths of up to 6 inches. This sloughing appeared to be the result of the relatively steep slopes, the fact that the additional fill added in 1979 appeared to be poorly placed and not properly compacted, and the poor vegetal cover and erosion on the dam. An area of minor sloughing on the downstream slope is shown on Photograph 5. There is no riprap or other protection against wave action but wave action has caused only minor erosion of the lake shoreline. The shoreline should be monitored and erosion protection provided if the erosion becomes serious. No surface cracks or unusual movement or cracking at or beyond the toe of the dam were noticed. No evidence was found of animal holes or burrows on the embankment. The crest of the dam is nearly void of vegetation. The upstream slope is sparsely vegetated with weeds, brush and trees (see Photos 1, 2, 3 and 4). Photos 5 and 6 show that portions of the downstream slopes are fairly well covered with vegetation while other areas are nearly bare. No trees were observed on the crest or downstream toe of the dam. There are numerous erosion gullies (especially along the downstream slope) on the embankment. These gullies appear to be uniformly distributed and vary from 3 inches to 12 inches deep. No evidence of seepage through or under the dam was observed.

No instrumentation (monuments, piezometer gages, etc.) was observed.

D. Appurtenant Structures:

D.1 Principal Spillway:

The principal spillway is a channel cut into the original ground just right of the right abutment. Downstream from the control section of the spillway, the channel bends sharply to the left (see Plate 4). A woven wire fence crosses the downstream channel of the spillway. The approach to the spillway channel is unobstructed and is only sparsely vegetated. The left slope of the spillway is steep and shows evidence of sloughing (see Photos 7, 8 and 9).

A profile of the centerline of the spillway is shown on Exhibit 5 of Appendix B. A cross section of the spillway at the crest is shown on Exhibit 4 of Appendix B. A cross section of the spillway at the centerline of the dam also appears on Exhibit 3 of Appendix B.

The crest elevation of the spillway is approximately 409.9 The low point in the crest of the dam is taken to be 412.4 providing a freeboard of approximately 2.5 feet. It is not known where the owner made the observation, but he reported that the highest lake level was approximately 3 feet below the crest of the dam. Based on this information, an apparent high water elevation of 410 was estimated, giving an indication that the spillway overflows infrequently.

D.2 Emergency Spillway:

There is no emergency spillway associated with this dam.

E. Reservoir and Watershed:

The watershed for Bartlett's Fishing Lake Dam is not well defined since there are gravel pits in the upper extremes of the watershed. The gravel pits are now inactive and one of these pits has been converted to a landfill disposal area (see Photo 16).

In addition to the gravel pits there are two small ponds created by small dams constructed across the main drainage ditch upstream of Bartlett's Fishing Lake Dam. The location of these ponds is shown on Exhibit 1 of Appendix B. Each of these small dams have embankment heights of about 10 feet and estimated maximum storage capacities of about 3 acre-feet. These ponds had small pipe spillways through the dams and earth channel emergency spillways.

The remaining area in the watershed consists of several home sites, some pasture land, a heavily wooded area and the reservoir itself. At the spillway crest the reservoir constitutes approximately 24% of the watershed area and at the top of dam elevation the reservoir is approximately 27% of the watershed.

Slopes in the watershed are variable but average approximately 10 to 15%. Typical views of the watershed area are shown in Photos 13, 14, 15 and 16.

Most of the watershed has soil belonging to the Loring group which is in hydrologic group C as defined by the S.C.S. No evidence of excessive siltation was noted during the inspection. The two upstream ponds help to keep siltation of the lake minor by slowing runoff and trapping sediment.

F. Downstream Channel:

Flood flows in Bartlett's Fishing Lake discharge through an irregular earth channel cut into natural ground (see Photo 9). The channel bends sharply to the left just downstream from the dam, then back to the right. At the right bend in the channel there is an earth embankment (dike) several feet in height located on the left bank of the channel. This dike appears to have been placed to divert flow away from the dam. The channel does not discharge to the original stream but crosses into another watershed to the west. The spillway discharge channel and original stream channel are shown on Exhibit 1 of Appendix B.

The flow line of the spillway channel is non-uniform in slope (see Exhibit 5 of Appendix B). Since there is sparse vegetal cover in the channel, some erosion can be expected when there is flow through the spillway. Most of the erosion would occur where the slopes are steepest. Such erosion would likely not cause a breach of the dam. The spillway does not discharge into the main watershed drainage channel (see Plate 4).

The main channel just downstream from the dam is shallow and lined with trees. Adjacent to the channel are several residences and a commercial establishment located just below the dam (see Photo 11). The stream crosses U.S. Highway 60 and passes through a fairly densely populated commercial and residential development just prior to discharging into Dudley Main Ditch. The horizontal slope of the downstream channel is fairly steep until it reaches the developed areas, then becomes very flat. The valley slopes downstream from the dam are flat.

3.2 EVALUATION:

The steep embankment slopes present a condition that may contribute to instability. This is of particular concern since the steepest slopes are near the top of the embankment. Lack of adequate vegetal cover over much of the embankment may cause excessive erosion and sloughing that, when present on steep embankment slopes, can cause rapid deterioration and instability. Trees located on the upstream slopes can also present serious stability and seepage problems. As the trees continue to grow, the root system could go laterally through the embankment and provide seepage paths. Also if the trees are blown over during a storm, large sections of the embankment can be weakened. It would be desirable to cut the trees, remove the stumps, fill the holes, compact and restore the vegetation on the disturbed areas. Trees in the shallow downstream channel may result in restriction to flow should a dam breach occur. This would cause banks to overflow flooding structures located along the banks and would induce flooding into developed areas.

The spillway discharge channel is subject to erosion during flood flows, but may not result in a dam breach since the erosion would be principally confined to the channel which is cut into the original earth. The channel should be provided with adequate protection against erosion. The fence crossing the spillway could catch debris during flood flows and cause a restriction to flow (See Photo 9). Consideration should be given to improving the size of openings in the fence or other modifications to minimize this condition.

It should be noted that Bartlett's Fishing Lake Dam is located in or near Seismic Zone 3. Seismic Zone 3 delineates areas in which major damage would result from the expected seismic activity in the area. The lack of seepage and a stability analysis is a deficiency which should be corrected. Seepage and stability analyses should include an allowance for seismic loadings.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

There is no operating equipment at Bartlett's Fishing Lake. The water level is controlled by rainfall, runoff, evaporation, seepage of the lake water into the ground, and overflow through the earth spillway.

4.2 MAINTENANCE OF DAM:

The maintenance of the dam is the responsibility of the owner. Maintenance of the dam is provided on an "as needed" basis. There appears to have been little or no maintenance performed on the dam or spillway in the past few years.

4.3 MAINTENANCE OF OPERATING FACILITIES:

There are no operating facilities requiring maintenance at the dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

No warning system is known to exist.

4.5 EVALUATION:

The dam and spillway should be more adequately maintained. Sloughed and eroded areas should be repaired and a suitable vegetal cover and other means provided to control sloughing and erosion. Trees and brush should be removed from the dam. The spillway channel should be maintained free of obstructions and provided with a good vegetal (grass) cover. Remedial measures should be investigated by an engineer experienced in the design and construction of dams. Subsequently, these items should be inspected periodically to insure the safety of the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. Design Data:

No hydrologic or hydraulic design computations are available for this dam.

The significant dimensions of the dam and reservoir were measured or surveyed during the inspection or estimated from available topographical mapping. The map used in the analysis is the 7.5 minute U.S.G.S. quadrangle sheet for Dexter, Missouri, dated 1963 and photorevised 1979. Surface soil information is available from a map obtained from the S.C.S., Bloomfield, Missouri District Office.

B. Experience Data:

No recorded rainfall, runoff, discharge, or reservoir stage data are available for this lake and watershed. Information received from Mr. Joe Vinson indicated that the high water level was about three feet below the top of the dam.

C. Visual Observations:

A description of the watershed and reservoir is given in Paragraph 3.1E and a description of the spillway is given in Paragraph 3.1D.1. The lake level has apparently normally fluctuated below the spillway crest elevation since the highest level observed by the owner was at about the spillway crest elevation. The lake level is primarily controlled by evaporation, rainfall, runoff and seepage of the lake water into the ground. The crest of the spillway is approximately 2.5 feet below the low point in the crest of the dam and the spillway capacity is approximately 464 cfs before overtopping of the dam begins.

A description of the downstream channel is given in Paragraph 3.1F. The downstream hazard zone extends approximately one mile downstream from the dam. Numerous residences, U.S. Highway 60 and commercial establishments fall within this zone. A commercial building is located near the downstream channel less than 100 feet from the toe of the dam.

D. Overtopping Potential:

Based on the hydrologic and hydraulic analysis presented in Appendix B, this structure has the capacity to store and pass approximately 85 percent (to the nearest 5 percent) of the Probable Maximum Flood (PMF) without being overtopped. The Probable Maximum Flood is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in a region. The recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that this structure (small size with high downstream hazard potential) pass 50 percent to 100 percent of the PMF without overtopping. The dam has a relatively small height of 20 feet, a small maximum storage capacity of 76 acre-feet, and a small drainage area of 44.5 acres. The floodplain is nearly flat for almost 1,000 feet on each side of the downstream channel. Therefore, flood or dam breach

discharges could be expected to spread out and obtain maximum depths of only several feet on the floodplain and the chance for loss of life is considered small. Considering this, 50 percent of the PMF has been determined to be the appropriate spillway design flood. Thus the spillway capacity of this dam is considered adequate. Obviously, the dam and spillway will also hold and pass the 1 percent probability flood without overtopping the dam.

The Hydrologic/Hydraulic Standards prepared by the Corps of Engineers, St. Louis District provide that an antecedent storm shall be half the magnitude of the PMF ratio storm being analyzed and precede that PMF ratio storm by four days. An antecedent storm of 25% PMF was used for analysis of the 50% PMF and an antecedent storm of 50% PMF was used for analysis of the 100% PMF. In both cases the lake level returned to the spillway crest elevation of 409.9 within four days and this was used as the starting elevation for the analysis.

Data for the 50 percent PMF, the 85 percent PMF, and the 100 percent PMF are presented in the table below.

Percent PMF	Starting Pool Elevation (MSL)	Peak Inflow To Lake (cfs)	Maximum Pool Elevation (MSL)	Maximum Depth Over Dam (feet)	Peak Discharge (cfs)	Overtopping Duration (hours)
50%	409.9	561	411.60	0.00	224	0.0
85%	409.9	953	412.35	0.00	447	0.0
100%	409.9	1121	412.62	0.22	572	0.33

During a flood the magnitude of the 50% PMF, discharges in the spillway are expected to reach critical velocities and erosion of the spillway channel will occur. However, the effects of erosion are not anticipated to cause the dam to breach. Nonetheless, erosion protection in the spillway should be provided.

Where the outlet channel (downstream from the spillway) bends to the right a small earthen embankment was constructed on the channel bank (see Plate 4 and Photograph 9. This dike acts as a barrier to prevent the channel from overflowing and diverts the flow away from the dam. If the dike eroded away during a flood it appears the flow would spread out over a wide area and there would be minimal effects on the dam.

The two small ponds upstream from Bartlett's Fishing Lake Dam both have dam heights of about 10 feet and maximum storage capacities of about 3 acre-feet. An overtopping analysis was done assuming that these small dams breach when the water level in each pond reaches the top of each dam. Inclusion of these ponds in the analysis changes the percentage of the PMF that Bartlett's Fishing Lake Dam can hold and pass without overtopping by only 2 or 3 percent. For simplicity, the results and computer output presented in this report assumed that the effects of the small ponds could be discounted since their effect on the overtopping percentage of the PMF is very minor.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY:

A. Visual Observations:

Observed features which could adversely affect the structural stability of this dam are discussed in Section 3 of this inspection report.

B. Design and Construction Data:

Design data are unavailable.

Seepage and stability analyses comparable to the requirement of the inspection guidelines are also not available. This situation constitutes a deficiency which should be corrected.

C. Operating Records:

No operating records have been obtained.

D. Post-Construction Changes:

A reported post-construction change consisted of the placement of 1.0 to 2.0 feet of reddish-brown clay over the entire width of the crest and faces of the embankment. The owner also reported that a portion of the downstream face near the edge of the crest and located near the center portion of the dam had been replaced with compacted borrow material. The reason for this repair was apparently some localized sloughing. A gravel surface was placed over the crest to allow vehicular access.

E. Seismic Stability:

This dam is located in or near Seismic Zone 3, as shown on the Seismic Zone Map on Plate 3 of Appendix A. Zone 3 delineates areas in which major damage would result from the expected seismic activity in this area. An accurate slope stability analysis with seismic loading cannot be made because of the lack of original design data and soil strength parameters. It should be noted that slopes of the embankment vary and some are relatively steep. Due to this factor, in the event of seismic loading, some of the slopes may become unstable and suffer damage, possibly severe.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

A. Safety:

Several items were noticed during the field inspection that could adversely affect the safety of the dam. These items are: (1) steep slopes, minor sloughing, poor vegetal cover and moderate to considerable erosion on the embankment slopes; (2) trees and brush along the upstream face of the embankment; (3) fence across the downstream channel of the spillway; (4) poor vegetal cover in the spillway channel; and (5) the earth channel spillway which has a potential for erosion during overflow events.

Another deficiency was the lack of seepage and stability analyses. This deficiency should be corrected, especially in consideration of the steep slopes.

B. Adequacy of Information:

The conclusions in this report were based on the performance history as related by others, and visual observation of external conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the Recommended Guidelines for Safety Inspection of Dams were not available, which is considered a deficiency.

C. Urgency:

The remedial measures recommended in Paragraph 7.2 should be accomplished in the near future. If the deficiencies listed in Paragraph A are not corrected, and if good maintenance is not provided, the embankment condition will continue to deteriorate and possibly could become serious in the near future. Embankment slopes are steep and subject to erosion; thus prompt attention is recommended for this deficiency.

D. Necessity for Additional Inspection:

Based on the results of the Phase I inspection, additional periodic inspections are recommended.

7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

A. Recommendations:

(1) A seepage and stability analysis comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the construction of dams. Since the dam is located in or near Seismic Zone 3, the analysis should include seismic loadings.

(2) The embankment slopes are expected to be significantly affected by potential seismic loadings. Provisions should be made to properly stabilize the embankment slopes to prevent potential instability. This stabilization should control the minor sloughing that has been occurring. Such work should be accomplished based upon the engineering analyses recommended in Item (1) above.

B. Operation and Maintenance Procedures:

(1) Erosion gullies on the dam and spillway channel should be repaired and reseeded.

(2) Under the guidance of an engineer experienced in the design and construction of earth dams, remove the trees from the dam. Stumps and roots should also be removed. Disturbed areas should be refilled and compacted and seeded.

(3) A good permanent vegetal cover should be established on the embankment slopes and spillway channel.

(4) The spillway should be kept free of obstructions (the fence crossing the spillway has the potential to catch debris and restrict flow).

(5) The spillway should be modified to minimize or eliminate erosion during overflow events.

(6) A detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams.

PHASE I INSPECTION REPORT

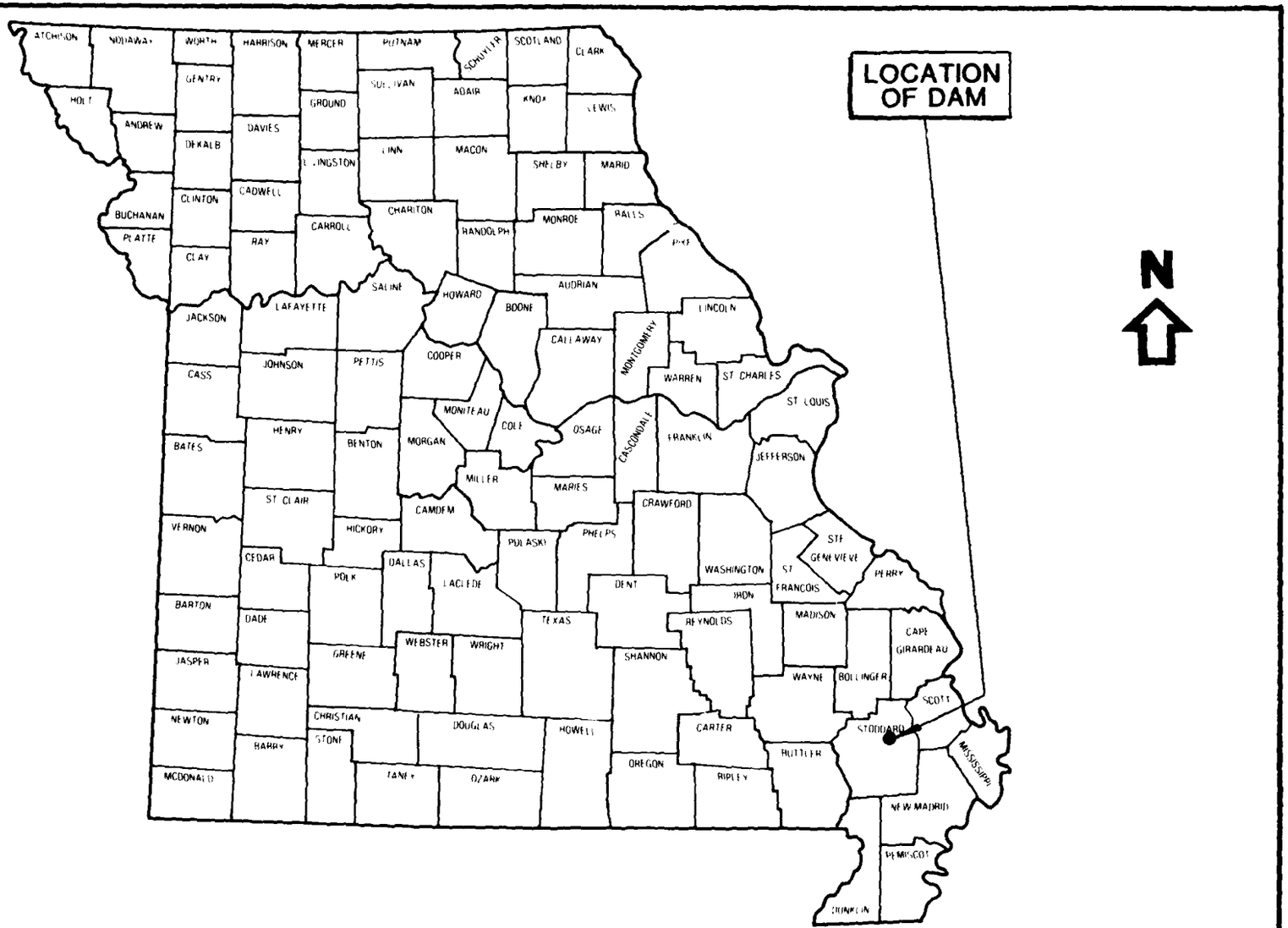
APPENDIX A

MAPS AND GENERAL DRAWINGS

APPENDIX A

MAPS AND GENERAL DRAWINGS

TABLE OF CONTENTS



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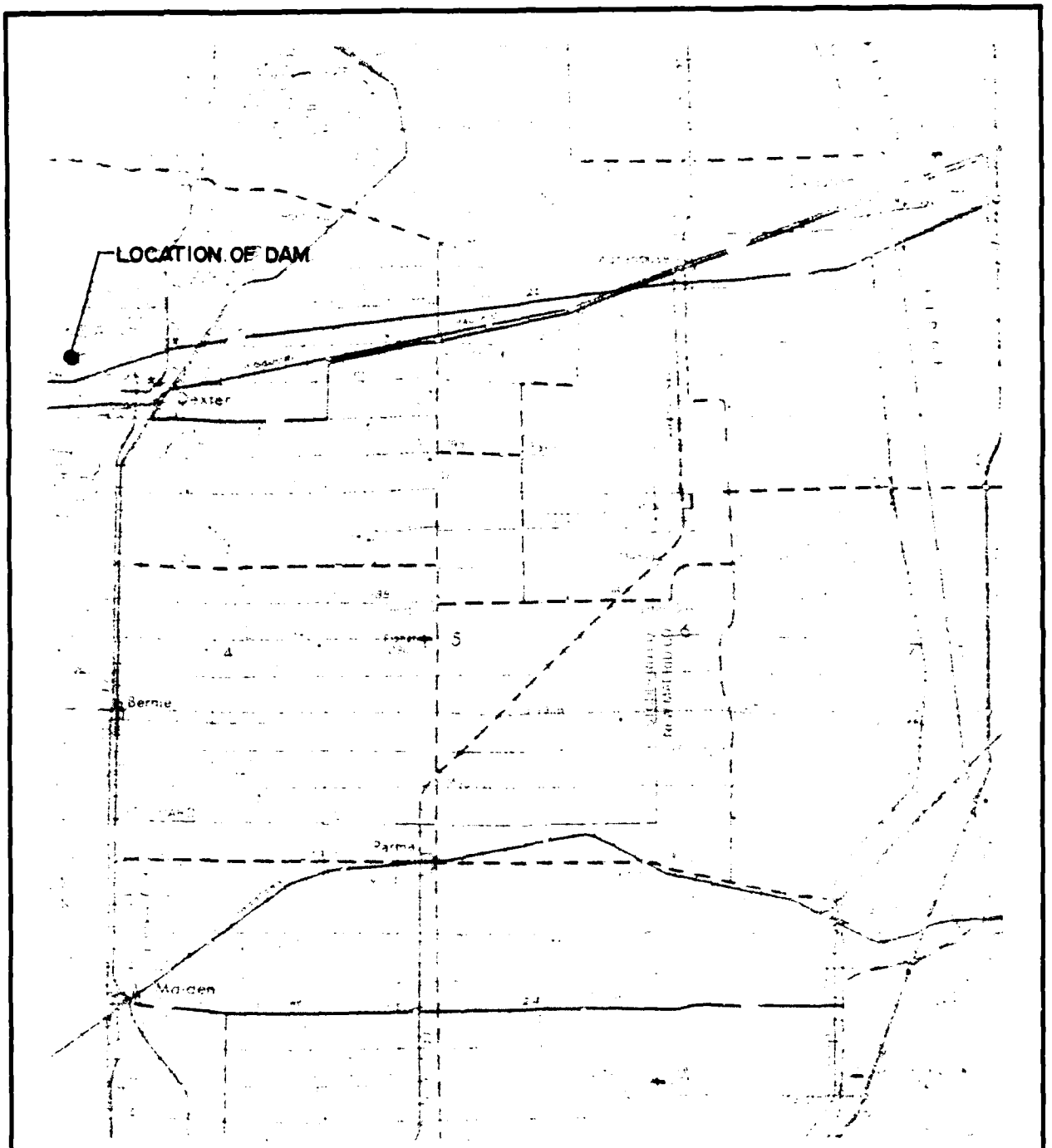
LOCATION MAP

BARTLETT'S FISHING LAKE DAM MO.40046

PLATE 1

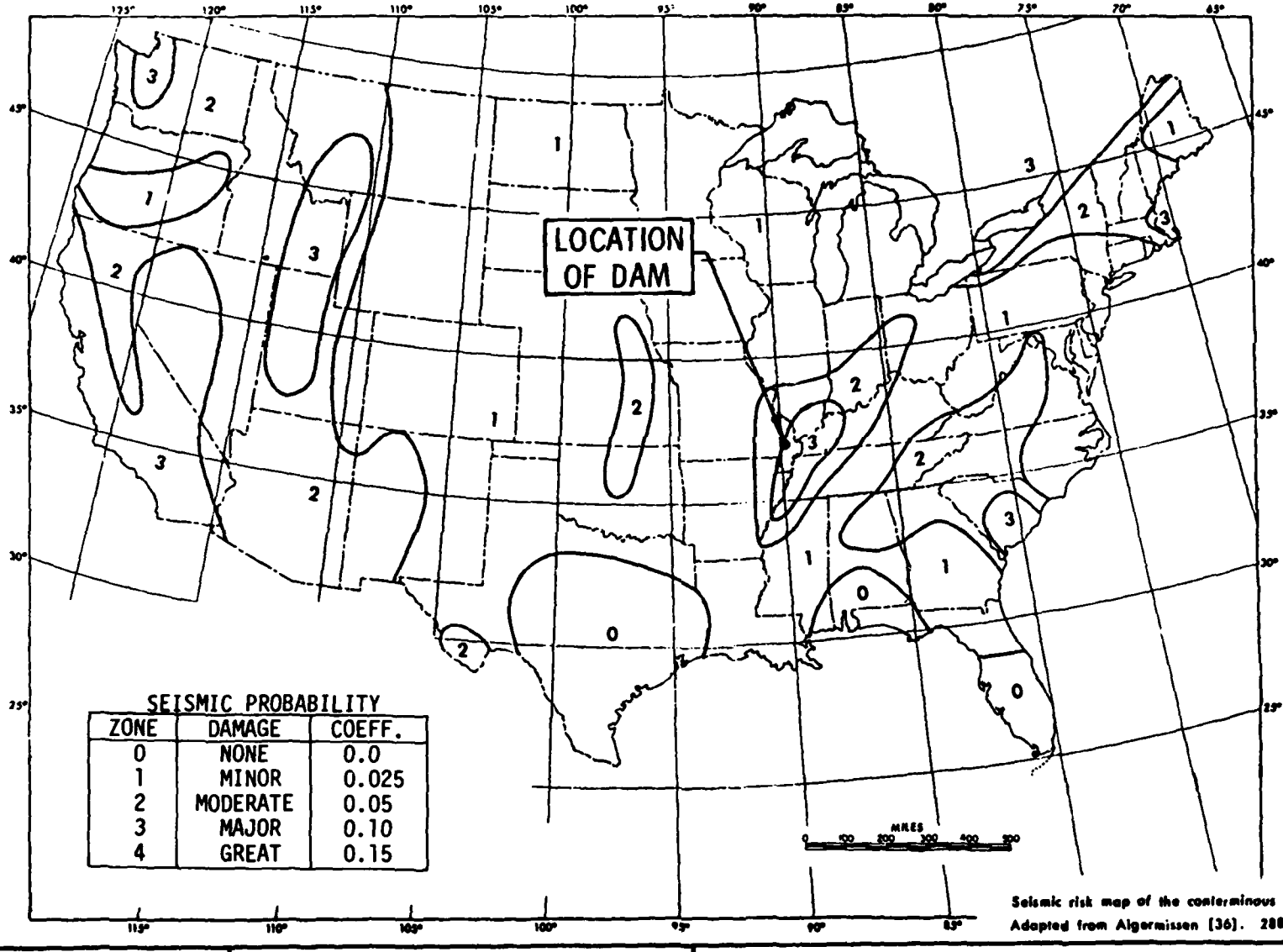


N

SCALE
1:250,000

CM&T	U.S. ARMY ENGINEER DISTRICT, ST. LOUIS CORPS OF ENGINEERS NATIONAL DAM SAFETY PROGRAM	VICINITY MAP BARTLETT'S FSH. LAKE DAM MO40046

PLATE 2



SEISMIC PROBABILITY

ZONE	DAMAGE	COEFF.
0	NONE	0.0
1	MINOR	0.025
2	MODERATE	0.05
3	MAJOR	0.10
4	GREAT	0.15

Seismic risk map of the conterminous United States.
Adapted from Algermissen [36]. 288-D-2786.

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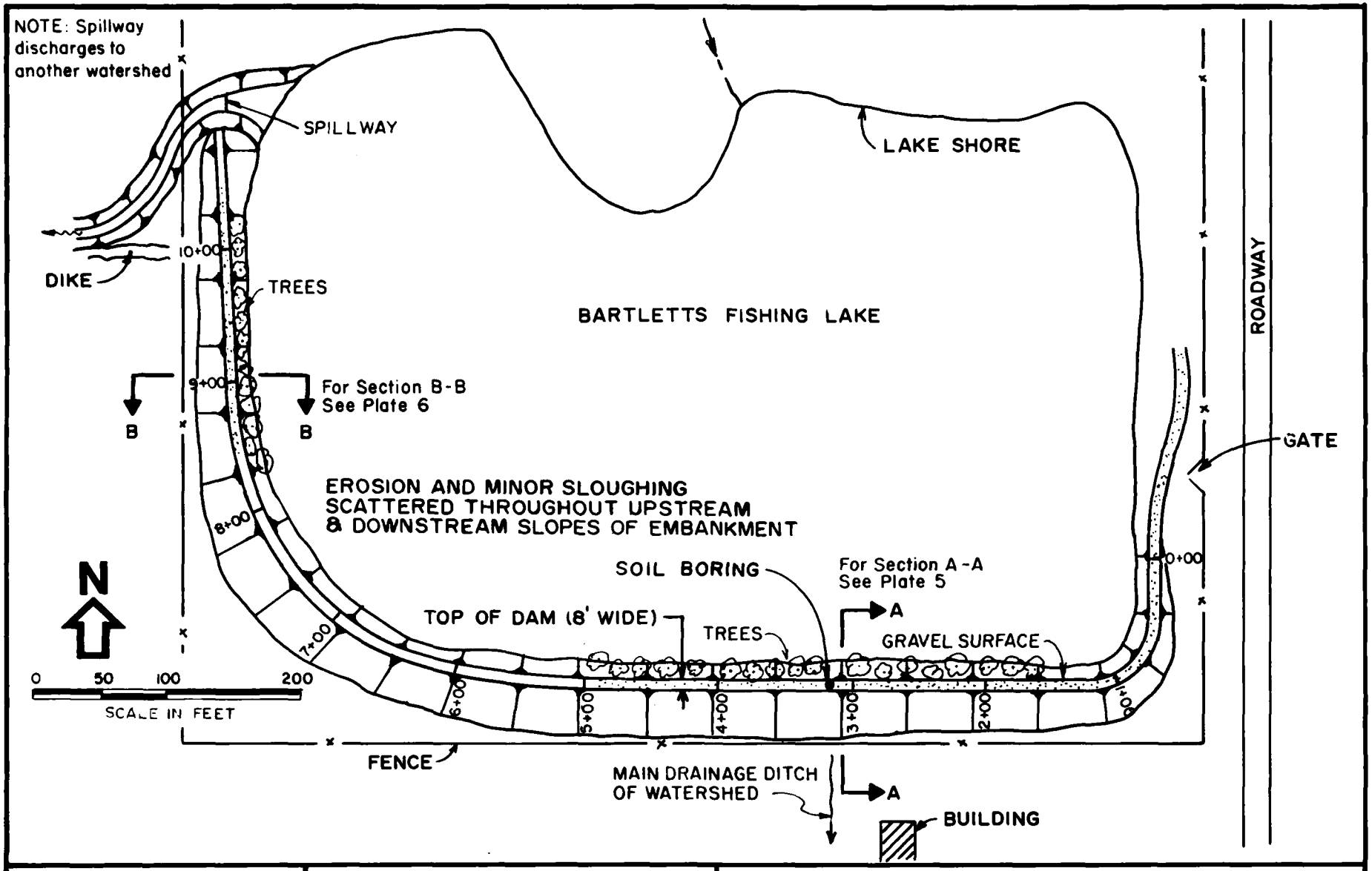
SEISMIC ZONE MAP OF CONTIGUOUS STATES
BARTLETT'S FISHING LAKE DAM MO.40046

PLATE 3



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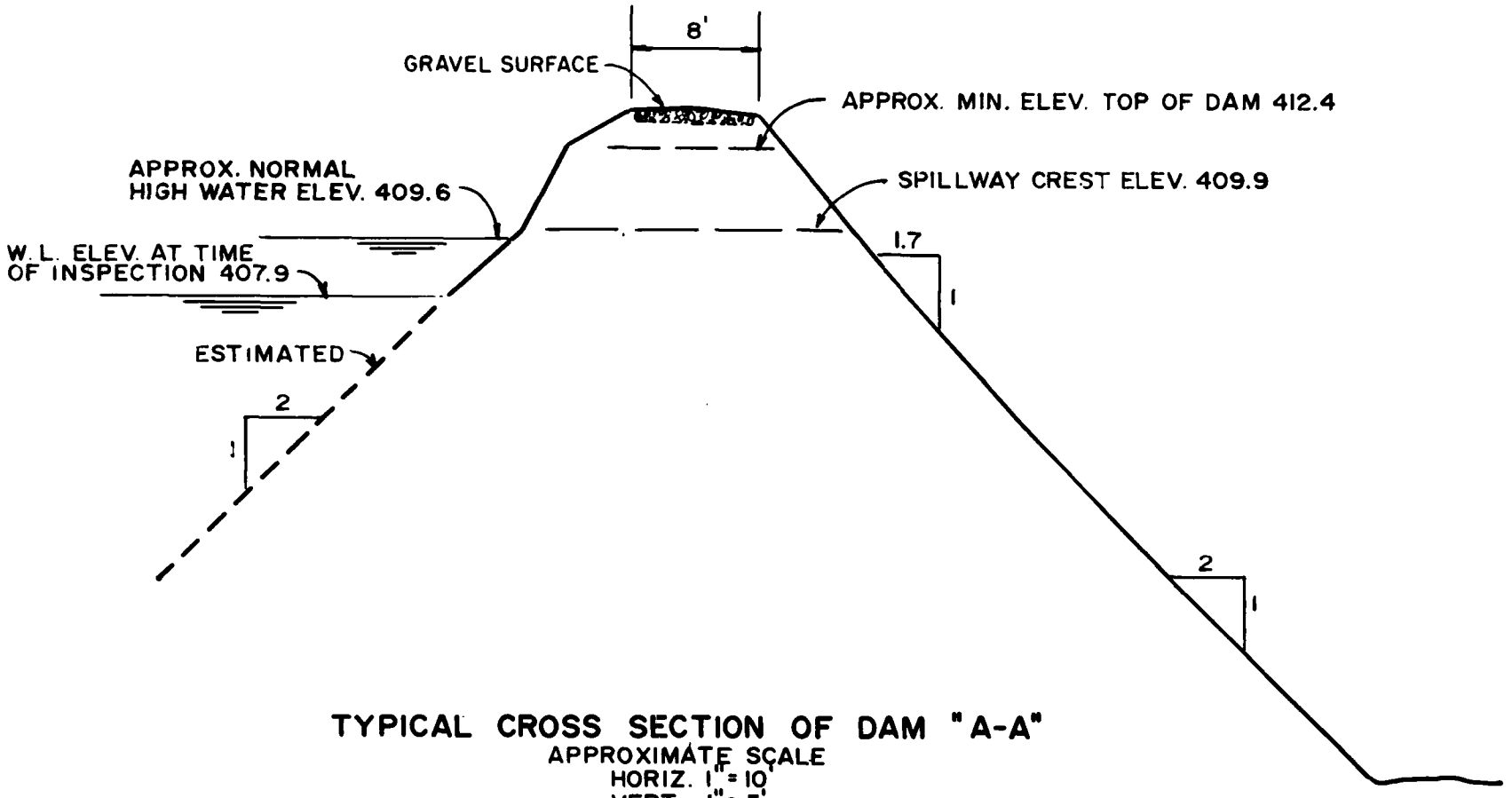
PLAN OF DAM AND SPILLWAY
BARTLETT'S FISHING LAKE DAM MO40046



TYPICAL CROSS SECTION OF DAM "A-A"

APPROXIMATE SCALE
HORIZ. 1" = 10'
VERT. 1" = 5'

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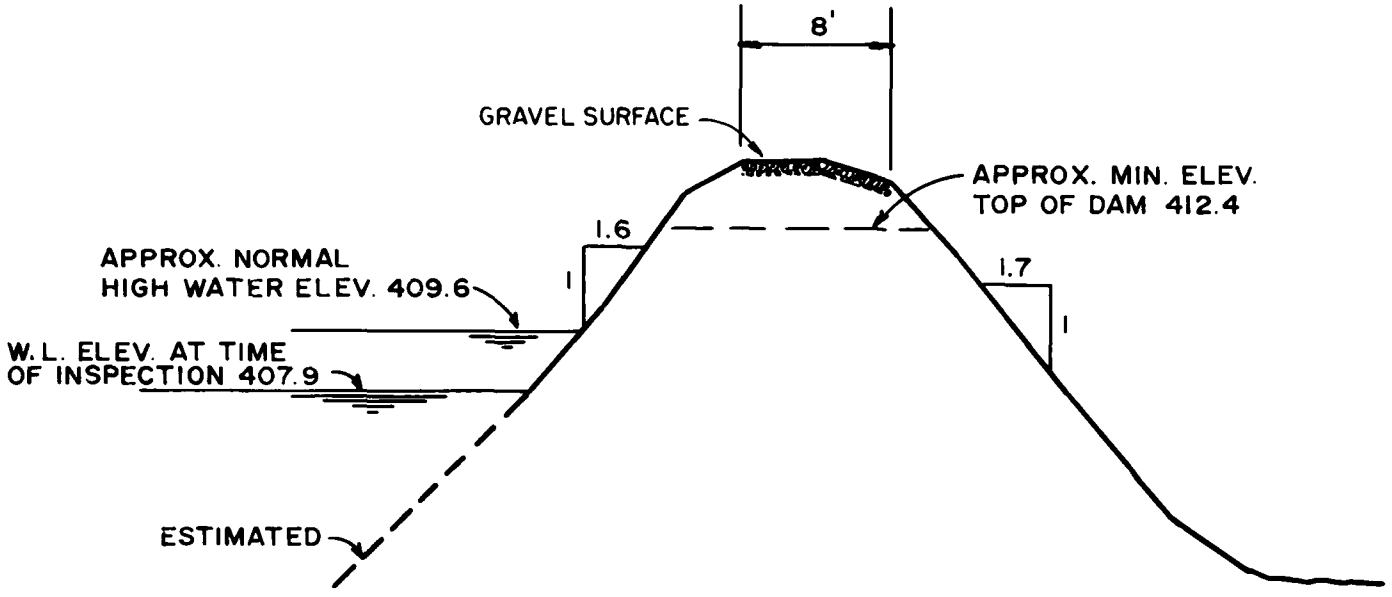

TYPICAL CROSS SECTION OF DAM "B-B"

APPROXIMATE SCALE
HORIZ. 1" = 10'
VERT. 1" = 5'

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PHASE I INSPECTION REPORT

APPENDIX B

HYDROLOGIC AND HYDRAULIC ANALYSIS

APPENDIX B

HYDROLOGIC AND HYDRAULIC ANALYSIS

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EXHIBITS

APPENDIX B

HYDROLOGIC AND HYDRAULIC ANALYSIS

A. PURPOSE:

The purpose of this Appendix is to present the methodology used and the results of the hydrologic and hydraulic analysis. The analysis was done according to criteria presented in the Recommended Guidelines for Safety Inspection of Dams and in the St. Louis District Hydrologic/Hydraulic Standards for Phase I Safety Inspection of Non-federal Dams dated 22 August, 1980. The purpose of the analysis is to determine the overtopping potential for Bartlett's Fishing Lake Dam.

B. HYDROLOGIC AND HYDRAULIC ANALYSIS:

The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for a reservoir routing. Data for determination of the unit hydrograph was obtained from the U.S. Geological Survey 7.5 minute quadrangle map for Dexter, Missouri, dated 1963 and photorevised in 1979 and from the field inspection. A lake and watershed map is shown on Exhibit 1. The parameters used in the development of the unit hydrograph are presented in Table 1.

TABLE 1

UNIT HYDROGRAPH PARAMETERS

Drainage Area (A)	44.5 acres
Length of Watercourse (L)	2500 feet
Difference in Elevation (H)	100 feet
Time of Concentration (Tc)	11 minutes
Duration (D)	0.03 hours
(Duration of 5 minutes, which is the smallest HEC-1 allows, was used for the computer program)	
Time to Peak (T_p)	0.129 hours
Peak Flow (Q_p)	261 cfs
Synder's Lag (Lg)	0.114 hours
Snyder's Peaking Coefficient (Cp)	0.67

Unit Hydrograph from the Computer Output

Time (Minutes)	Discharge (cfs)
0	0
5	125
10	233
15	136
20	35
25	9
30	2

Formulas Used:

$$Tc = .0078 \left[\frac{L^{3/2}}{H^{1/2}}\right]^{0.770}$$

Equation by P. Z. Kirpich, Civil Engineering, June 1940. (Verified by overland flow time plus channel flow time)

$$Lg = 0.6\ Tc$$

$$Tp = D/2 + Lg$$

Q = Excess Runoff = 1 inch

$$Qp = \frac{484\ AQ}{Tp}$$

$$Cp = \frac{Qp\ Lg}{A}$$

The hypothetical storm that is applied to the unit hydrograph is the Probable Maximum Precipitation (PMP). It is derived and determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." No reduction factors have been applied to the PMP. A 1 percent probability storm was also analyzed. A 24-hour storm duration is assumed with total depth distributed over 6-hour periods in accordance with procedures outlined in EM 1110-2-1411 (SPF determination). The maximum 6-hour rainfall period is then distributed to hourly increments by the same criteria. Within-the-hour distribution is based upon NOAA Technical Memorandum NWS HYDRO-35. The non-peak 6-hour rainfall periods are distributed uniformly. All distributed values are arranged in a critical sequence by the SPF. The final inflow hydrograph is produced by deduction of infiltration losses appropriate to the soil, land use, and antecedent moisture conditions. Soil information was obtained from mapping available from the Soil Conservation Service. The S.C.S. hydrologic group C was used for this analysis. Land use and slopes were determined from the field inspection and available mapping. Antecedent Moisture Condition II (AMC II) was used for the analysis of the 1 percent probability storm and AMC III was used for the analysis of the PMP percentage storms. The rainfall applied, the parameters used to determine infiltration losses and the resulting runoffs are presented in Table 2.

TABLE 2

RAINFALL-RUNOFF PARAMETERS

Selected Storm Event	Storm Duration (hours)	Rainfall (inches)	Runoff (inches)	Losses (inches)
PMP	24	35.75	35.10	0.65
1% Probability Storm	24	7.25	5.50	1.75

Additional Data:

1) Soil Conservation Service Runoff Curve Number CN = 93 (AMC III) for ratios of the PMF.

2) Soil Conservation Service Runoff Curve Number CN = 79 (AMC II) for the 1% probability storm

3) Percentage area of drainage basin impervious = 27%.

The reservoir routing is accomplished by using the Modified Puls routing technique wherein the flood hydrograph is routed through lake storage. The hydraulic capacity of the spillway and the crest of the dam are used as outlet controls in the routing. Storage in the pool area is defined by an elevation-storage capacity curve. The hydraulic capacity of the spillway and top of the dam are defined by elevation-discharge curves.

The elevation-storage capacity curve was developed by determining the lake surface area at various elevations using available mapping and then computing the volume at selected elevations using the conic method. An Elevation-Area-Capacity curve is shown on Exhibit 2.

For the overtopping analysis the top of the dam was determined by simple field surveys to be elevation 412.4 feet which is the minimum elevation of the embankment. The profile of the spillway channel is shown on Exhibit 5 and reveals that the spillway crest has a steep bottom slope of 20% for a short distance. Outflow velocities in this portion of the spillway will cause scouring and erosion of the spillway crest. For this report, the capacity of the spillway was computed assuming that the spillway cross sections and profile at the time of the field survey remain intact throughout the spillway design flood. The hydraulic capacity of the spillway was computed using methods found in the U.S. Department of Agriculture, Soil Conservation Service, Technical Release No. 2, Earth Spillways, dated October 1956. The profile of the spillway flow line and cross sections of the spillway channel as surveyed in the field were used in this determination and they are shown on Exhibits 4 and 5. The elevation vs. spillway capacity input to the computer is shown in Table 3.

TABLE 3

LAKE ELEVATION VS. SPILLWAY CAPACITY

Values Input To The HEC-1 Computer Program

Lake Elevation (MSL)	Spillway Capacity (cfs)
409.9	0
410.4	22
410.9	81
411.4	174
411.9	296
412.4	464
412.9	710

The dam overtopping analysis has been conducted by hydrologic methods for this dam and lake. This analysis determines the percentage of the PMF hydrograph that the reservoir can contain without the dam being effectively overtopped. According to "Hydrologic/Hydraulic Standards" developed by the Corps of Engineers, St. Louis District, an antecedent storm should be applied

to the watershed before analysis of the PMF. The antecedent storm precedes the storm being analyzed by 4 days and the starting elevation at the beginning of the antecedent storm is the mean annual high water mark. Since no mean annual high water mark could be determined for Bartlett's Fishing Lake, the crest of the spillway or elevation 409.9 was used as the starting elevation at the beginning of the antecedent storms. The antecedent storm for the analysis of the PMF ratio storms is one-half the storm being analyzed. The starting elevations, antecedent storms, and storms analyzed are given in Table 4.

TABLE 4

ANTECEDENT STORMS AND STARTING ELEVATIONS

Starting Elevation Before Antecedent Storm	Antecedent Storm Used	Elevation At Start of Storm Being Analyzed	Storm Being Analyzed
409.9	25% PMF	409.9	50% PMF
409.9	50% PMF	409.9	100% PMF

The above methodology has been accomplished for this report using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The numeric parameters estimated for this site and input to the program are listed on Exhibit 6. Definitions of these variables are contained in the "User's Manual" for the computer program.

The inflow and outflow hydrographs, obtained from the computer output, for the 50%, 85%, and 100% PMF storms are shown on Exhibits 7, 8, and 9. A summary table for the overtopping analysis is presented on Exhibit 10.

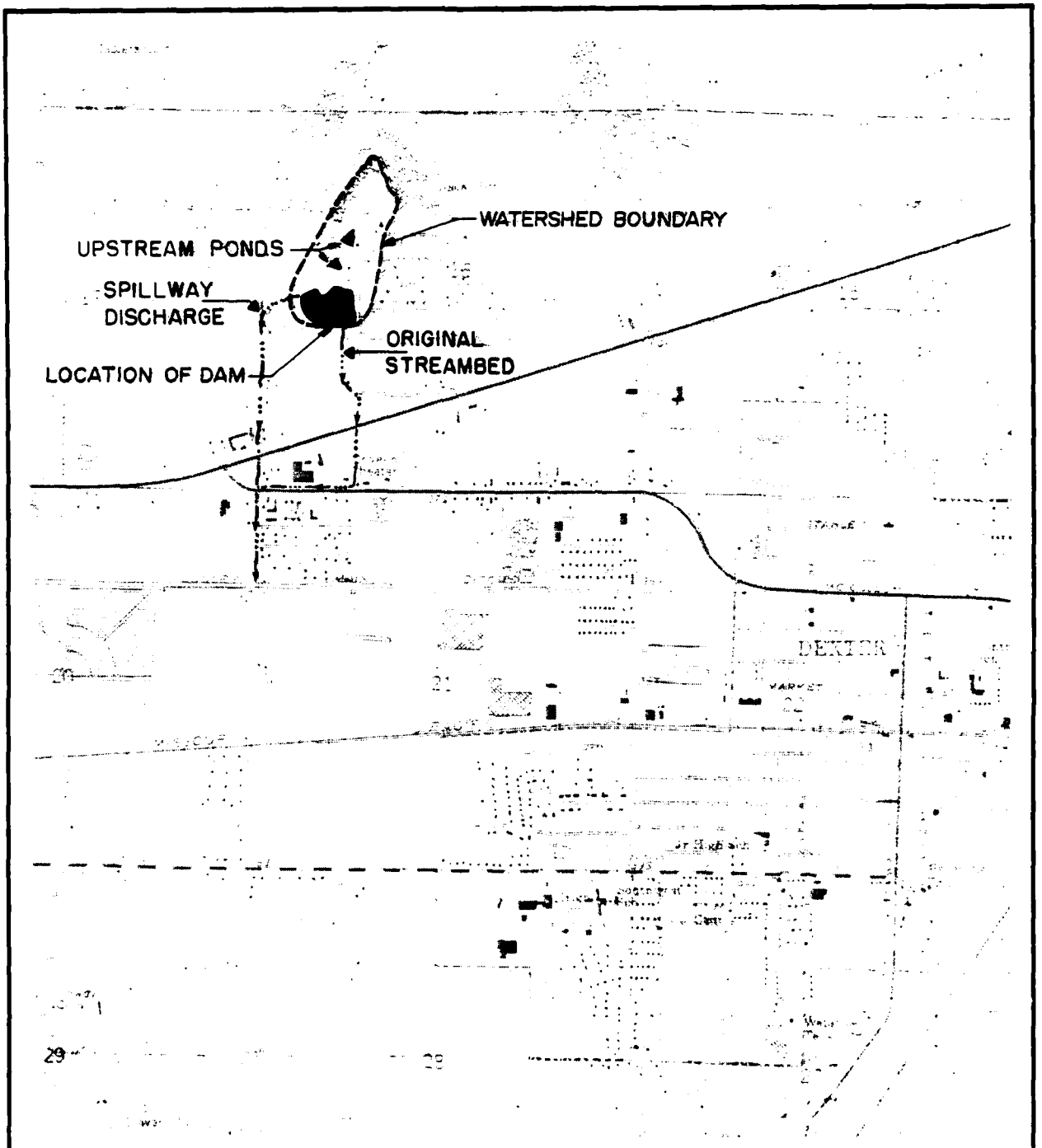
C. REFERENCES:

a. Earth Spillways, Technical Release No. 2, Soil Conservation Service, United States Department of Agriculture, Engineering Division, October, 1956.

b. Flood Hydrograph Package (HEC-1), Users Manual for Dam Safety Investigations, The Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California, September, 1978.

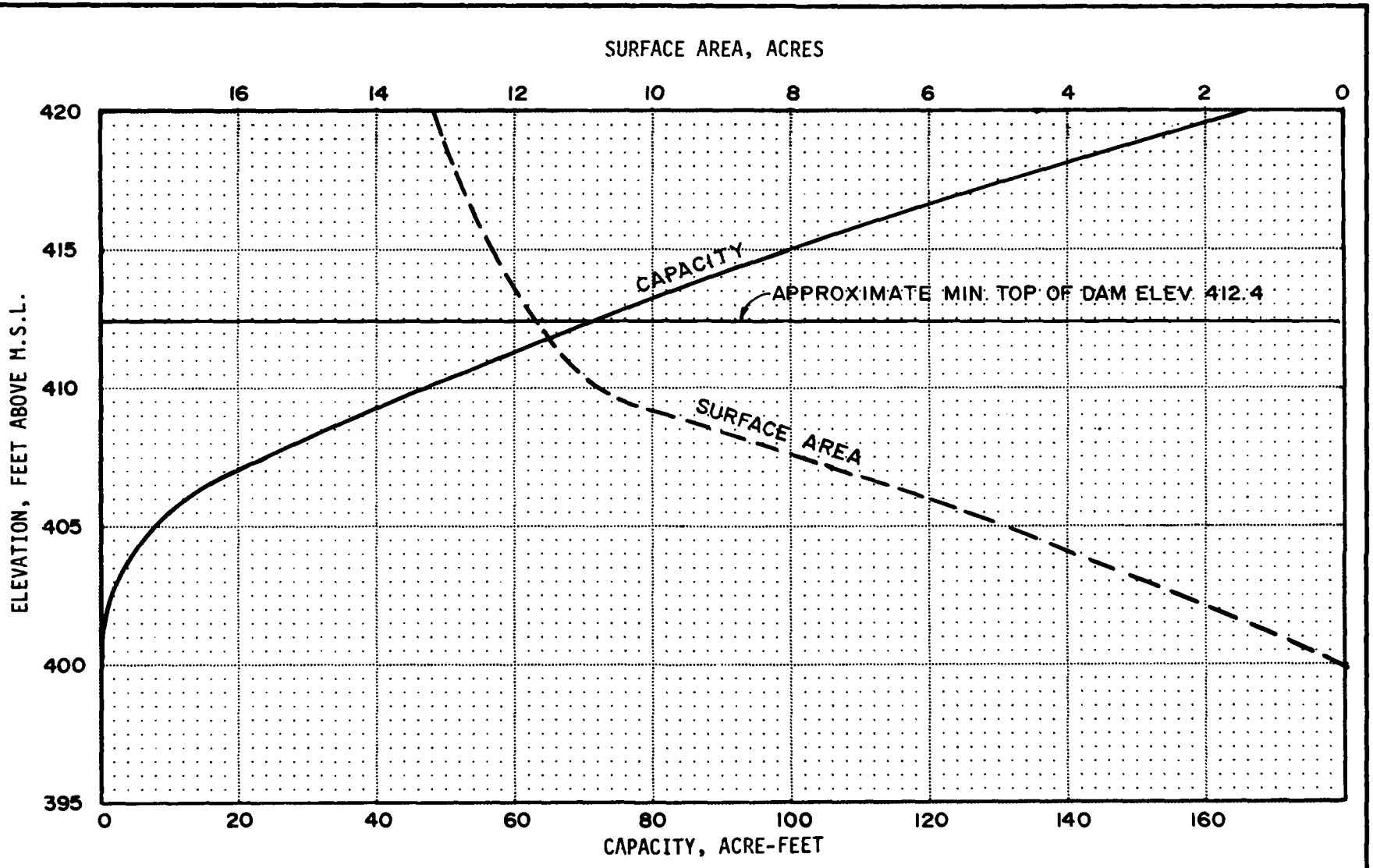
c. National Engineering Handbook, Sec. 4 - Hydrology, Supplement A; Soil Conservation Service, United States Department of Agriculture, 1957.

d. Riedel, J. T., Appleby, J. F., and Schloemer, R. W., Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1000 Square Miles and Durations of 6, 12, 24 and 48 Hours, Hydrometeorological Report No. 33, U.S. Department of Commerce, Weather Bureau, April 1956.



CMT	U.S. ARMY ENGINEER DISTRICT, ST. LOUIS CORPS OF ENGINEERS NATIONAL DAM SAFETY PROGRAM	LAKE AND WATERSHED MAP BARTLETT'S FSH. LK. DM. MO40046

EXHIBIT 1



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ELEVATION - AREA - CAPACITY RELATION
BARTLETT'S FISHING LAKE DAM MO40046

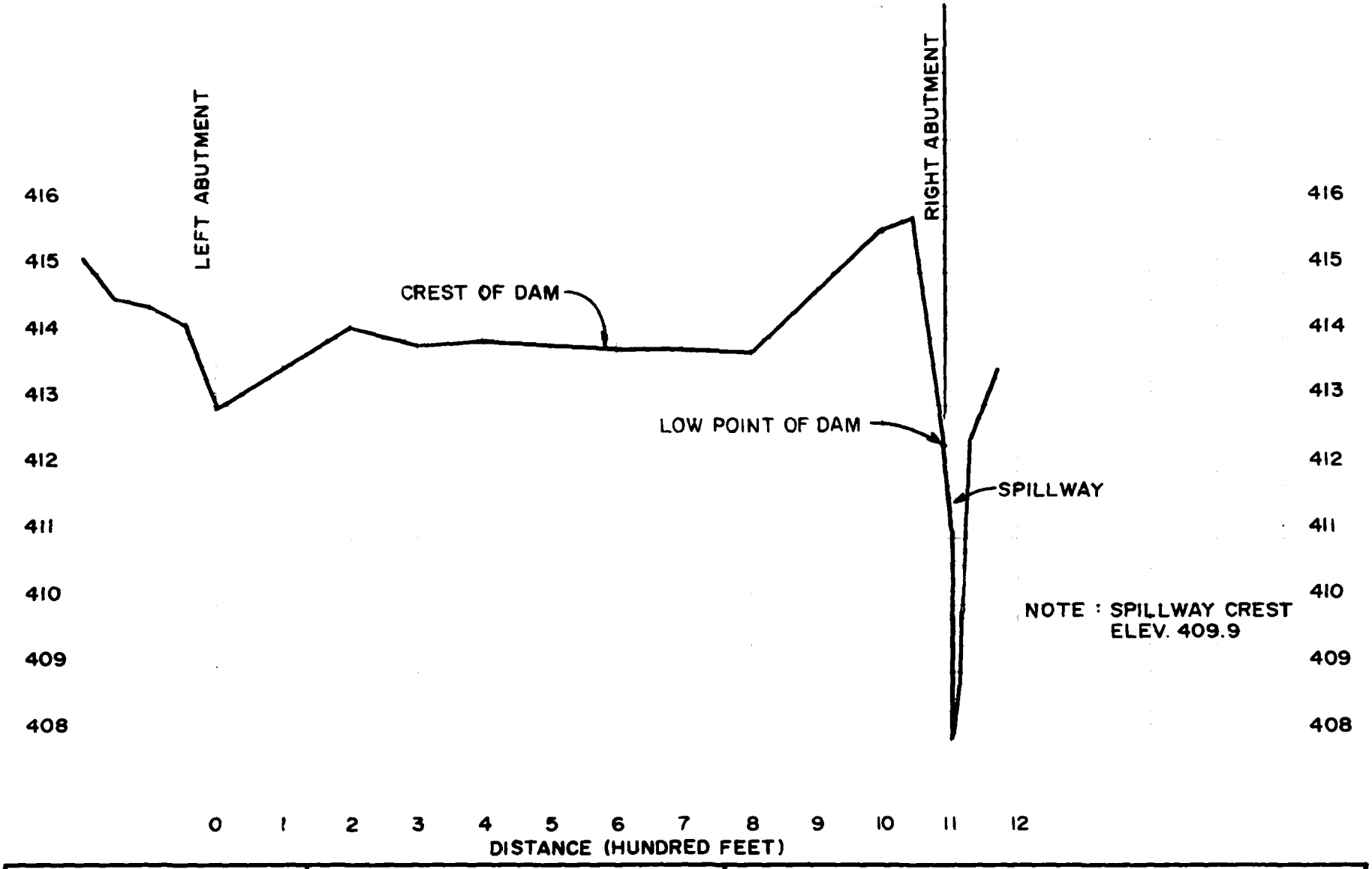
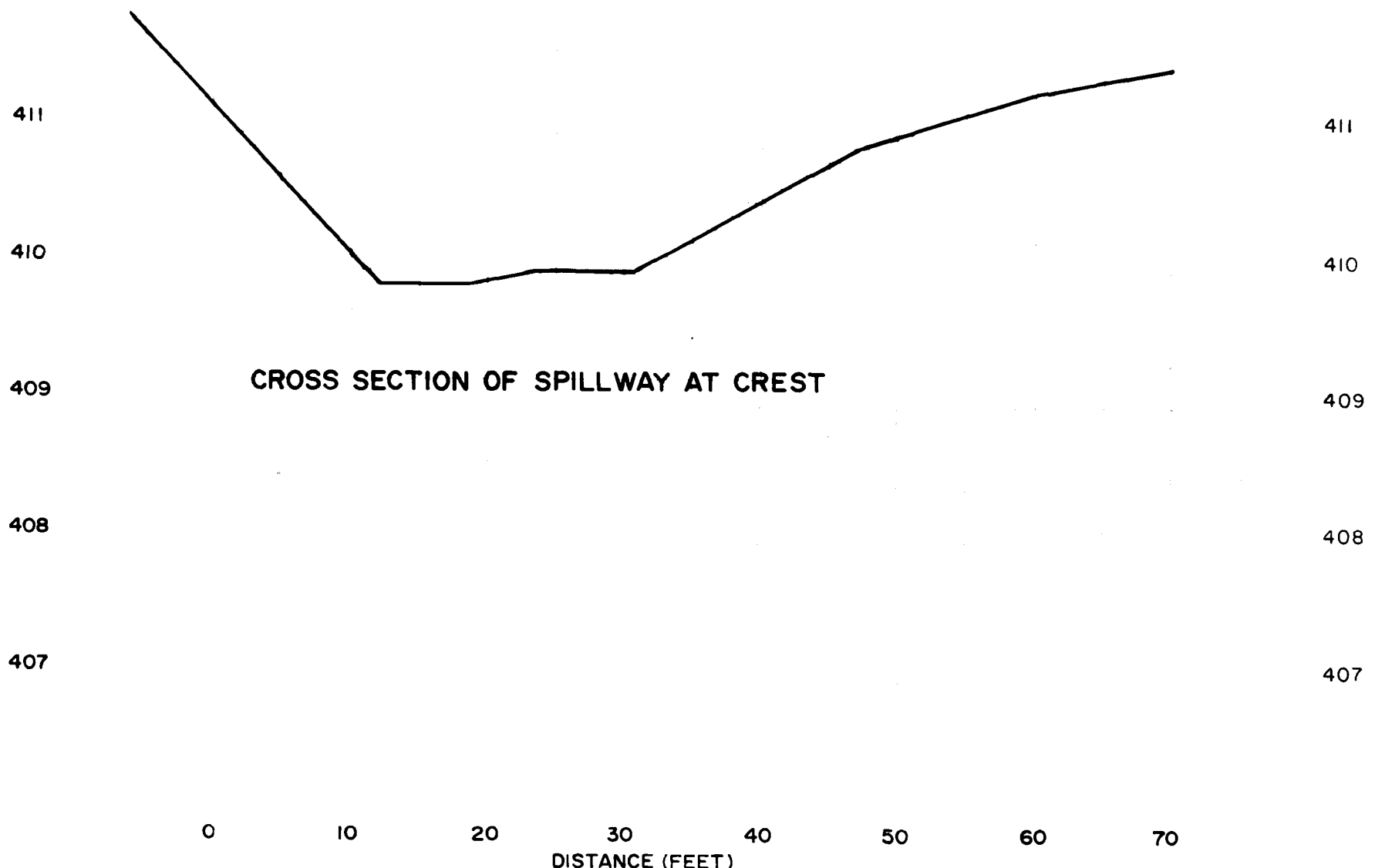


EXHIBIT 3

CRAWFORD MURPHY & TILLY, inc. Consulting Engineers SPRINGFIELD, IL • LINCOLN, IL • AURORA, IL	U.S. ARMY ENGINEER DISTRICT, ST. LOUIS CORPS OF ENGINEERS NATIONAL DAM SAFETY PROGRAM	PROFILE-CREST OF DAM BARTLETT'S FISHING LAKE DAM MO40046



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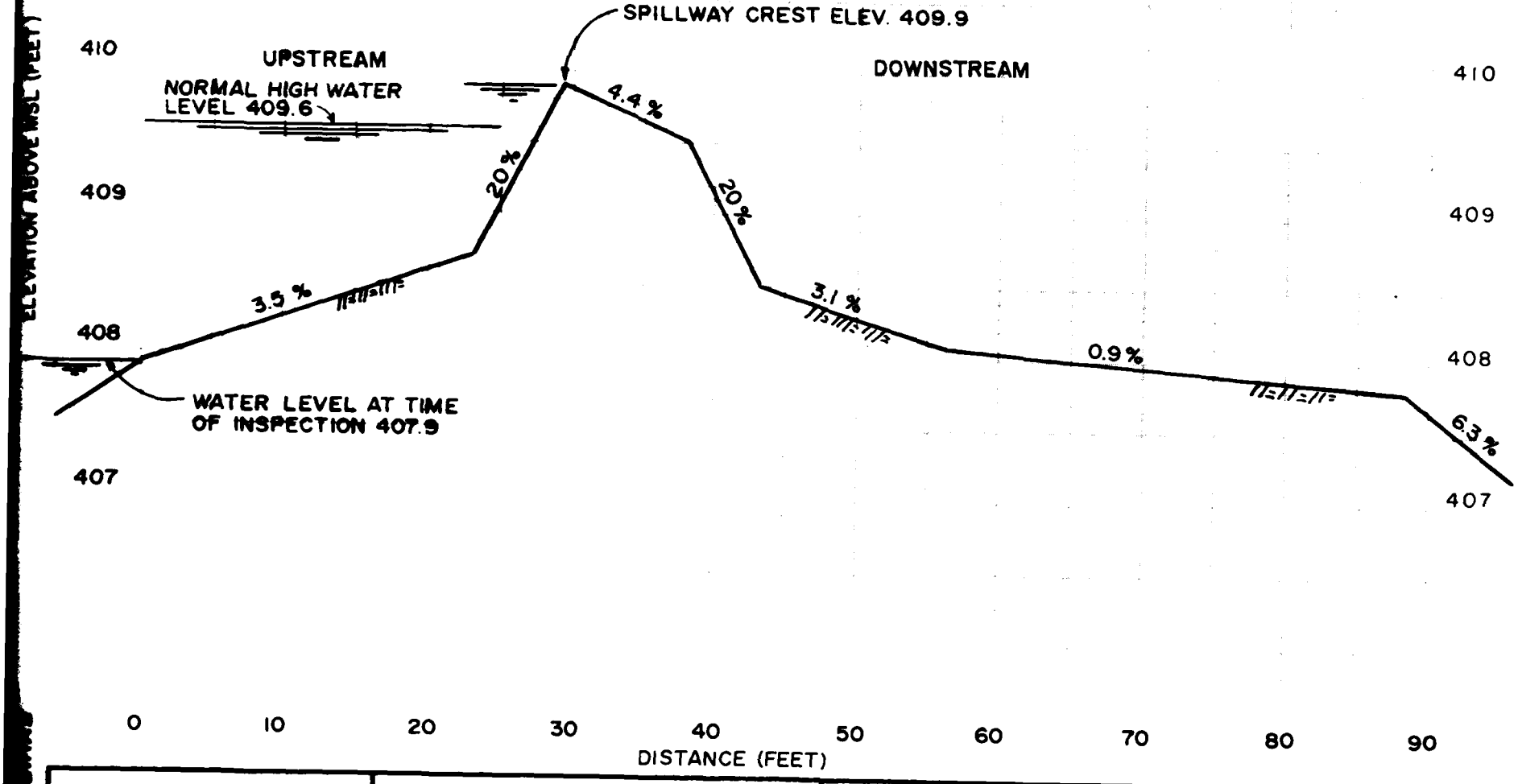

CLAYPOOLE, HOEPKER & TILLEY, Inc. Consulting Engineers SPRINGFIELD, IL • LINCOLN, IL • AURORA, IL	U.S. ARMY ENGINEER DISTRICT, ST. LOUIS CORPS OF ENGINEERS NATIONAL DAM SAFETY PROGRAM	SPILLWAY FLOWLINE PROFILE BARTLETT'S FISHING LAKE DAM MO40046

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

BARTLETT'S FISHING LAKE DAM MO40046

HEC-1 INPUT DATA

```
1A1 HYDROLOGIC AND HYDRAULIC ANALYSIS - BARTLETT FISHING LAKE MO40046
 A2 NATIONAL DAM SAFETY PROGRAM - CORPS OF ENGINEERS, ST. LOUIS DISTRICT
 A3 CM+T JOB NO. 8034-02
 B     288        0        5                                    0        0       -2
 B1      5
 J       1        9        1
 J1    .25      .50      .70      .75      .80      .85      .90      .95      1.0
 K       0  INFLOW                                              1
 K1 INFLOW HYDROGRAPH COMPUTATION
 M       1        1      .07                             1                        1
 P       0     27.5      102      120      130
 T                                                          -1      -93                 0.77
 W    .114      .67
 X       0     -.1     1.75
 K       1     LAKE                                          1
 K1 RESERVOIR ROUTING BY MODIFIED PULS METHOD
 Y                                        1        1
 Y1      1                                                -409.9       -1
 Y4  409.9    410.4    410.9    411.4    411.9    412.4    412.9
 Y5      0       22       81      174      296      464      710
 $S      0      8.3     20.4     47.2    167.0
 $E    400      405      407      410      420
 $$  409.9
 $D  412.4      2.6      1.5     1200
 $L      0       20      140      805     1010     1160     1200
 $V  412.4    413.0    413.5    414.0    414.5    415.0    415.2
 K      99
 A
```

EXHIBIT 6

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 2

0.	1.	1.	1.	1.	1.	1.	1.	1.	1.
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2.	2.	2.	2.	2.	2.	2.	2.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	4.
4.	4.	6.	12.	15.	16.	16.	17.	17.	17.
17.	17.	17.	17.	17.	17.	17.	18.	18.	18.
18.	18.	18.	18.	18.	18.	18.	18.	18.	18.
18.	18.	18.	18.	18.	18.	18.	18.	18.	18.
18.	18.	18.	18.	18.	18.	18.	18.	18.	18.
18.	18.	18.	18.	18.	18.	18.	18.	18.	18.
18.	18.	18.	18.	18.	18.	18.	18.	18.	18.
18.	18.	18.	18.	29.	48.	59.	62.	63.	63.
63.	63.	63.	63.	63.	63.	66.	71.	74.	75.
76.	76.	76.	76.	76.	76.	76.	76.	80.	88.
93.	94.	95.	95.	95.	95.	95.	95.	95.	95.
96.	83.	99.	124.	159.	253.	462.	561.	422.	268.
188.	142.	115.	99.	91.	89.	89.	88.	88.	88.
88.	88.	88.	88.	84.	76.	71.	70.	70.	70.
70.	70.	70.	70.	70.	70.	56.	53.	50.	47.
45.	42.	40.	38.	36.	34.	32.	30.	29.	27.
25.	24.	23.	22.	20.	19.	18.	17.	16.	15.
15.	14.	13.	12.	12.	11.	10.	10.	9.	9.
8.	8.	7.	7.	7.	6.	6.	6.	6.	6.
6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
6.	6.	6.	6.	6.	6.	6.	6.		

STATION LAKE, PLAN 1, RATIO 2

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	3.	3.	3.	3.
3.	3.	3.	3.	3.	4.	4.	4.	5.	5.
5.	6.	6.	6.	6.	7.	7.	7.	8.	8.
8.	8.	9.	9.	9.	9.	9.	10.	10.	10.
10.	10.	11.	11.	11.	11.	11.	12.	12.	12.
12.	12.	12.	12.	13.	13.	13.	13.	13.	13.
13.	14.	14.	14.	14.	14.	14.	14.	14.	14.
14.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	16.	16.	16.	16.	17.	18.	19.	21.
22.	24.	26.	29.	31.	33.	35.	37.	40.	42.
44.	46.	48.	50.	52.	53.	55.	56.	57.	59.
61.	63.	65.	67.	69.	71.	72.	74.	75.	76.
77.	78.	79.	81.	87.	99.	125.	165.	205.	223.
224.	216.	204.	192.	179.	169.	161.	153.	147.	141.
136.	131.	127.	123.	119.	115.	111.	107.	103.	100.
97.	94.	91.	89.	87.	85.	83.	80.	79.	77.
75.	73.	70.	68.	66.	64.	62.	60.	58.	56.
54.	52.	50.	48.	47.	45.	43.	42.	40.	38.
37.	35.	34.	32.	31.	30.	29.	27.	26.	25.
24.	23.	22.	22.	21.	21.	21.	20.	20.	19.
19.	19.	18.	18.	18.	18.	17.	17.	17.	17.
16.	16.	16.	16.	15.	15.	15.	15.	14.	14.
14.	14.	14.	13.	13.	13.	13.	13.		

CMT	U.S. ARMY ENGINEER DISTRICT, ST. LOUIS CORPS OF ENGINEERS NATIONAL DAM SAFETY PROGRAM	INFLOW-OUTFLOW HYDROGRAPHS 50% PMF BARTLETT'S FISHING LAKE DAM MO40046

EXHIBIT 7

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 6

0.	1.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	3.	3.	3.	3.	3.
3.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	5.	5.	5.	5.	5.	5.	5.	5.
5.	5.	5.	5.	5.	5.	5.	5.	5.	5.
5.	5.	6.	6.	6.	6.	6.	6.	6.	6.
6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
6.	6.	11.	20.	26.	27.	28.	28.	29.	29.
29.	29.	29.	29.	29.	30.	30.	30.	30.	30.
30.	30.	30.	30.	30.	30.	30.	30.	31.	31.
31.	31.	31.	31.	31.	31.	31.	31.	31.	31.
31.	31.	31.	31.	31.	31.	31.	31.	31.	31.
31.	31.	31.	31.	31.	31.	31.	31.	31.	31.
31.	31.	31.	31.	31.	31.	31.	31.	31.	31.
31.	31.	31.	31.	49.	81.	100.	105.	106.	107.
107.	107.	107.	107.	107.	107.	112.	121.	127.	123.
128.	129.	129.	129.	129.	129.	129.	129.	136.	150.
158.	160.	161.	161.	161.	161.	161.	161.	161.	161.
146.	142.	168.	211.	270.	431.	786.	953.	717.	466.
320.	241.	196.	168.	155.	151.	151.	150.	150.	150.
150.	150.	150.	150.	143.	129.	121.	119.	118.	118.
118.	118.	118.	118.	118.	118.	95.	80.	85.	80.
76.	72.	68.	64.	61.	57.	54.	51.	48.	46.
43.	41.	39.	37.	35.	33.	31.	29.	28.	26.
25.	23.	22.	21.	20.	19.	18.	17.	16.	15.
14.	13.	13.	12.	11.	11.	11.	11.	11.	11.
11.	11.	11.	11.	11.	11.	11.	11.	11.	11.
11.	11.	11.	11.	11.	11.	11.	11.	11.	11.
11.	11.	11.	11.	11.	11.	11.	11.		

STATION LAKE, PLAN 1, RATIO 6

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	5.	5.	5.	5.	6.	6.	7.	7.	8.
9.	9.	10.	10.	11.	11.	11.	12.	12.	13.
13.	14.	14.	14.	15.	15.	16.	16.	16.	17.
17.	17.	18.	18.	18.	19.	19.	19.	20.	20.
20.	20.	21.	21.	21.	21.	22.	22.	22.	23.
23.	24.	24.	25.	25.	26.	26.	26.	27.	27.
27.	27.	28.	28.	28.	28.	29.	29.	29.	29.
29.	29.	29.	30.	30.	33.	36.	41.	45.	49.
53.	56.	60.	63.	66.	68.	71.	74.	77.	81.
85.	90.	94.	97.	100.	103.	106.	108.	111.	114.
118.	122.	126.	130.	133.	136.	138.	140.	143.	144.
145.	145.	146.	151.	160.	181.	237.	328.	417.	447.
436.	409.	376.	341.	310.	286.	268.	253.	239.	225.
218.	209.	201.	194.	188.	181.	174.	168.	163.	159.
155.	151.	148.	145.	142.	140.	136.	132.	127.	123.
118.	114.	109.	105.	101.	96.	92.	88.	84.	81.
78.	76.	74.	71.	69.	67.	64.	62.	60.	58.
56.	54.	52.	50.	48.	46.	44.	42.	41.	39.
37.	36.	34.	33.	31.	30.	29.	28.	26.	26.
24.	24.	23.	22.	22.	21.	21.	21.	21.	20.
20.	20.	20.	19.	19.	19.	19.	19.	18.	18.
18.	18.	18.	17.	17.	17.	17.	17.		

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

INFLOW-OUTFLOW HYDROGRAPHS
85% PMF
BARTLETT'S FISHING LAKE DAM MO40046

EXHIBIT 8

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 9

1.	1.	2.	2.	2.	2.	2.	2.	3.	3.
3.	3.	3.	3.	3.	3.	3.	4.	4.	4.
4.	4.	4.	4.	5.	5.	5.	5.	5.	5.
5.	5.	5.	5.	5.	6.	6.	6.	6.	6.
6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
6.	6.	6.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	13.	24.	30.	32.	33.	33.	34.	34.
34.	34.	34.	35.	35.	35.	35.	35.	35.	35.
35.	35.	36.	36.	36.	36.	36.	36.	36.	36.
36.	36.	36.	36.	36.	36.	36.	36.	36.	36.
36.	36.	36.	36.	36.	36.	36.	37.	37.	37.
37.	37.	37.	37.	37.	37.	37.	37.	37.	37.
37.	37.	37.	37.	37.	37.	37.	37.	37.	37.
37.	37.	37.	37.	57.	96.	118.	124.	125.	126.
126.	126.	126.	126.	126.	126.	132.	143.	149.	151.
151.	151.	151.	151.	151.	151.	151.	151.	160.	176.
186.	188.	189.	189.	189.	189.	189.	189.	189.	189.
172.	167.	198.	249.	318.	507.	925.	1121.	843.	536.
376.	283.	230.	198.	182.	178.	177.	177.	177.	177.
177.	177.	177.	177.	168.	152.	142.	140.	139.	139.
139.	139.	139.	139.	139.	139.	112.	106.	100.	94.
89.	84.	80.	75.	71.	67.	64.	60.	57.	54.
51.	48.	46.	43.	41.	39.	36.	34.	33.	31.
29.	28.	26.	25.	23.	22.	21.	20.	19.	18.
17.	16.	15.	14.	13.	13.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.		

STATION LAKE, PLAN 1, RATIO 9

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	3.	3.	3.	3.	3.	3.
3.	3.	3.	3.	3.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	5.	5.
5.	5.	5.	5.	5.	5.	5.	5.	5.	5.
5.	5.	5.	6.	6.	7.	7.	8.	9.	9.
10.	11.	11.	12.	12.	13.	13.	14.	14.	15.
15.	16.	16.	17.	17.	18.	18.	19.	19.	20.
20.	20.	21.	21.	22.	22.	23.	24.	24.	25.
26.	27.	27.	28.	28.	29.	29.	30.	30.	31.
31.	31.	32.	32.	32.	33.	33.	33.	33.	34.
34.	34.	34.	34.	35.	35.	35.	35.	35.	35.
35.	35.	35.	36.	36.	39.	43.	48.	53.	58.
63.	67.	71.	74.	78.	81.	85.	91.	96.	102.
107.	111.	115.	119.	122.	125.	128.	130.	133.	136.
141.	146.	150.	154.	158.	161.	164.	166.	169.	171.
172.	172.	173.	179.	193.	221.	286.	413.	533.	572.
543.	490.	442.	401.	364.	332.	305.	286.	272.	259.
248.	239.	231.	224.	217.	210.	201.	194.	186.	180.
175.	171.	168.	165.	162.	160.	156.	152.	147.	142.
137.	131.	126.	122.	117.	112.	107.	103.	98.	94.
90.	86.	82.	79.	77.	74.	72.	69.	67.	65.
62.	60.	58.	56.	54.	52.	50.	48.	46.	44.
42.	41.	39.	37.	36.	34.	33.	32.	30.	29.
28.	27.	26.	25.	24.	24.	23.	22.	22.	22.
21.	21.	21.	21.	20.	20.	20.	20.	20.	20.
19.	19.	19.	19.	19.	19.	18.	18.		

CMS	U.S. ARMY ENGINEER DISTRICT, ST. LOUIS CORPS OF ENGINEERS NATIONAL DAM SAFETY PROGRAM	INFLOW-OUTFLOW HYDROGRAPHS 100% PMF BARTLETT'S FISHING LAKE DAM MO40046

EXHIBIT 9

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .25	RATIO 2 .50	RATIO 3 .70	RATIO 4 .75	RATIO 5 .80	RATIO 6 .85	RATIO 7 .90	RATIO 8 .95	RATIO 9 1.00
				RATIOS APPLIED TO FLOWS								
HYDROGRAPH AT	INFLOW	.07	1	200.	561.	785.	841.	897.	953.	1009.	1065.	1121.
	(	.18)	(	7.94)(	15.88)(	22.23)(	23.81)(	25.40)(	26.90)(	28.58)(	30.16)(	31.75)
ROUTED TO	LAKE	.07	1	87.	224.	346.	380.	414.	447.	486.	530.	572.
	(	.18)	(	2.47)(	6.33)(	9.80)(	10.77)(	11.73)(	12.65)(	13.76)(	15.00)(	16.21)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	409.90	409.90	412.40
STORAGE	46.	46.	76.
OUTFLOW	0.	0.	464.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.25	410.93	0.00	58.	87.	0.00	15.92	0.00
.50	411.60	0.00	66.	224.	0.00	15.92	0.00
.70	412.05	0.00	72.	346.	0.00	15.83	0.00
.75	412.15	0.00	73.	380.	0.00	15.83	0.00
.80	412.25	0.00	74.	414.	0.00	15.83	0.00
.85	412.35	0.00	75.	447.	0.00	15.83	0.00
.90	412.44	.04	76.	486.	.17	15.83	0.00
.95	412.53	.13	78.	530.	.25	15.83	0.00
1.00	412.62	.22	79.	572.	.33	15.83	0.00

CIVIL

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

HEC-1 SUMMARY TABLE

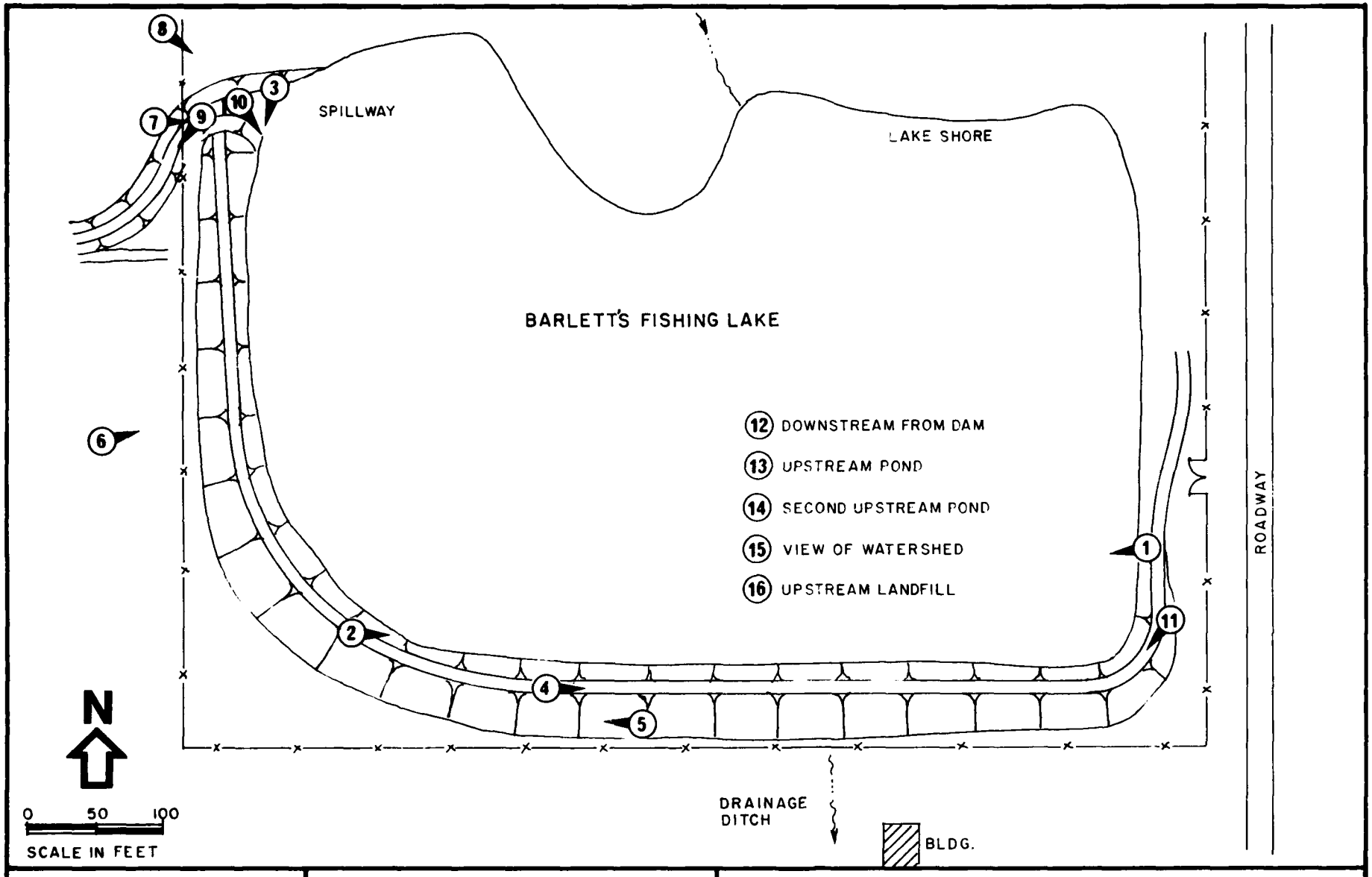
BARTLETTS FISHING LAKE DAM MO40046

EXHIBIT 10

PHASE I INSPECTION REPORT

APPENDIX C

PHOTOGRAPHS



CRAWFORD, MURPHY & TILLY, inc Consulting Engineers
SPRINGFIELD, IL • LINCOLN, IL • AURORA, IL

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
NATIONAL DAM SAFETY PROGRAM

PHOTOGRAPH INDEX
BARTLETT'S FISHING LAKE DAM MO40046

Photograph 2. Upstream face of dam viewed from right center of dam.

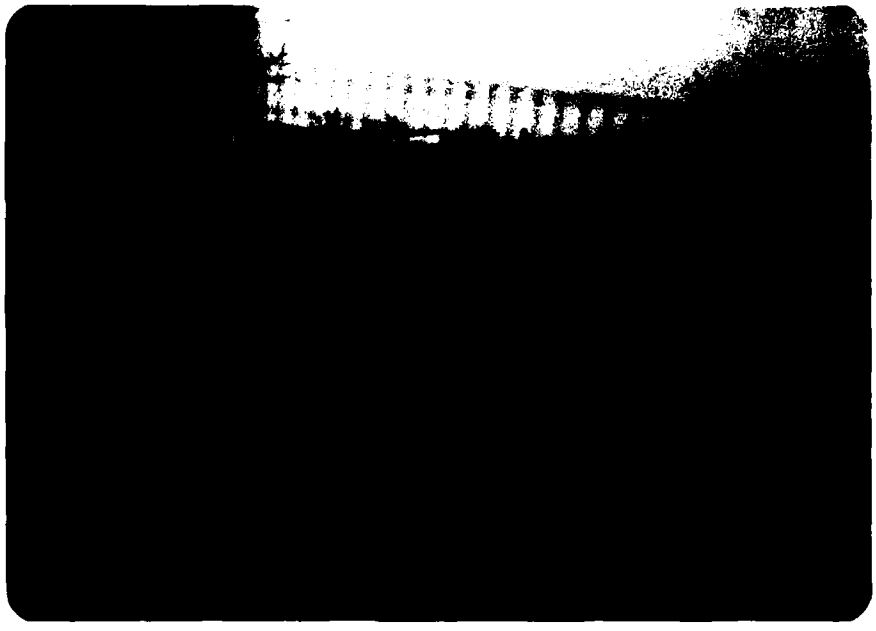
Photograph 3. Upstream face of dam viewed from right abutment.

Photograph 4. Crest of dam viewed from near center of dam.

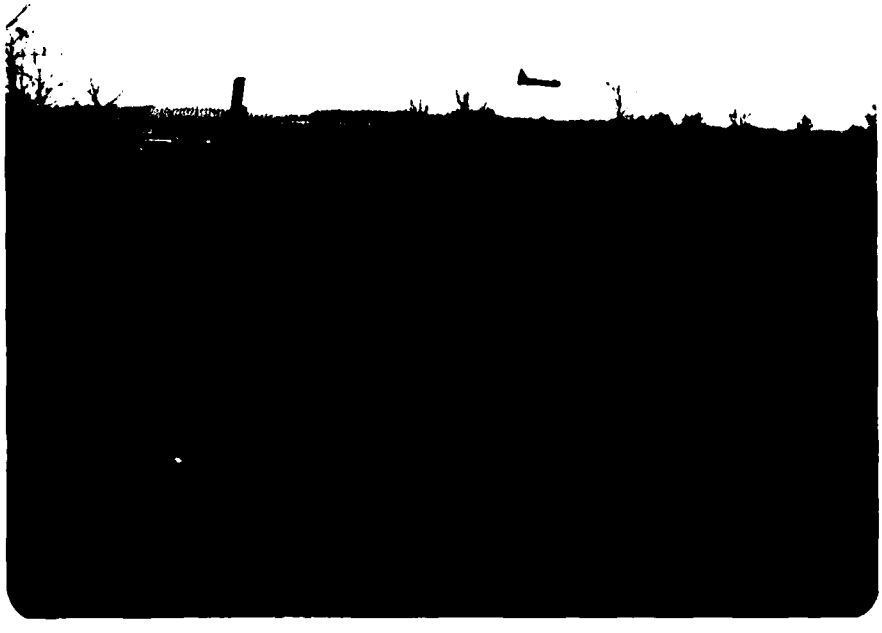
Photograph 5. Downstream face of dam near center.

Photograph 6. Downstream face of dam near right end of dam.

Photograph 7. View of spillway looking upstream toward crest.



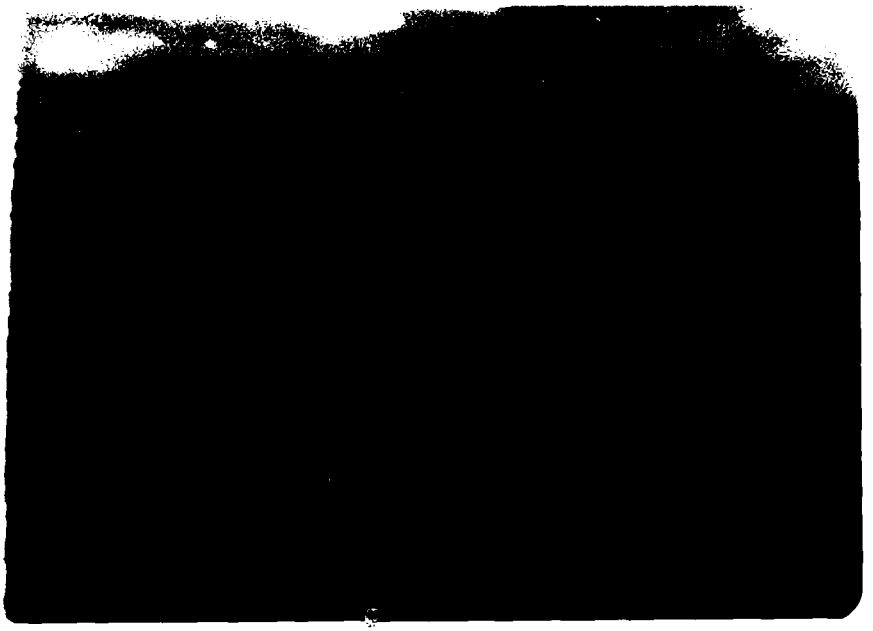
Photograph 8. View of spillway approach channel.



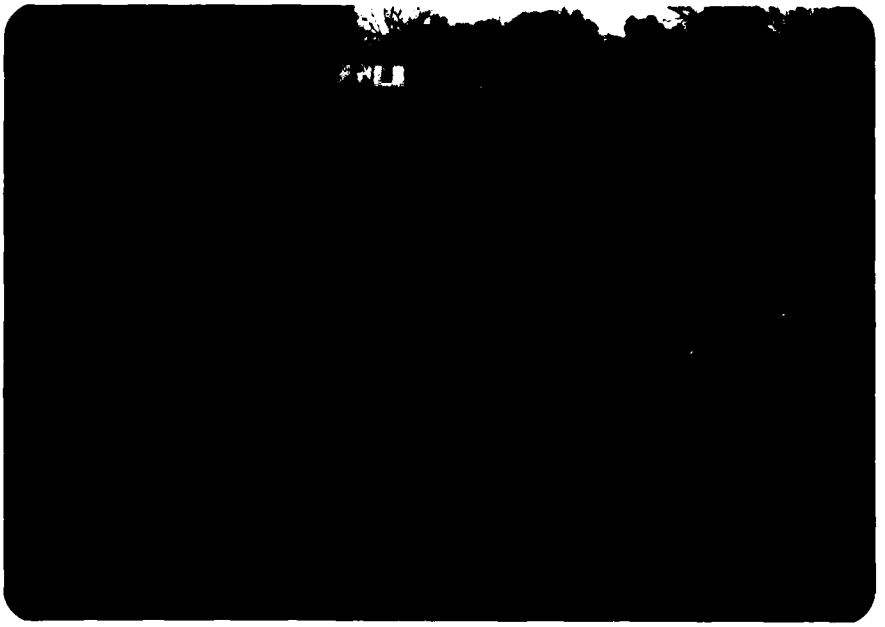
Photograph 9. View of downstream channel of spillway.

Photograph 10. View of lake from near spillway.

Photograph 11. View showing land development just downstream of dam looking from left abutment.



Photograph 12. View of dam and downstream area looking upstream. Note dam at left center of photo.



Photograph 13. Small dam located just upstream of Bartlett's Fishing Lake viewed from its right abutment.

Photograph 14. Second dam upstream from Bartlett's Fishing Lake looking downstream.

Photograph 15. View of watershed looking upstream.

Photograph 16. Abandoned gravel pit used for landfill in upper part of watershed.


DATE
ILME